Metal Finishing

POLISHING AND BUFFING · BARREL FINISHING · CLEANING
PLATING · ANODIZING · RUST PROOFING · LACQUERING & ENAMELING

JANUARY, 1961

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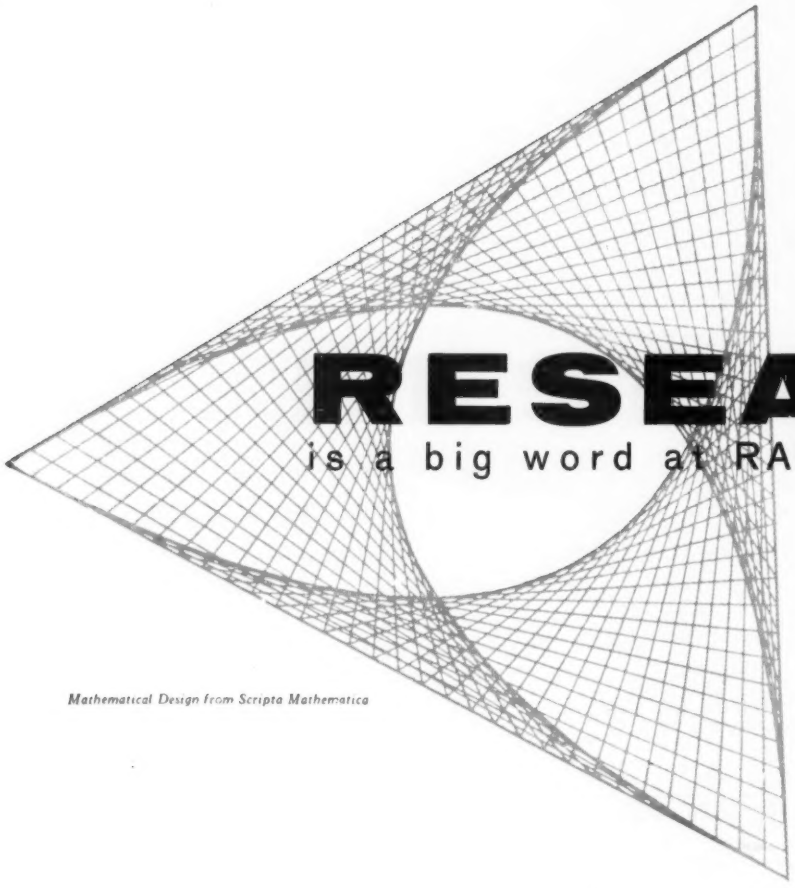
Read and pass on—

PLATING POWER BY DC POWER SPECIALISTS



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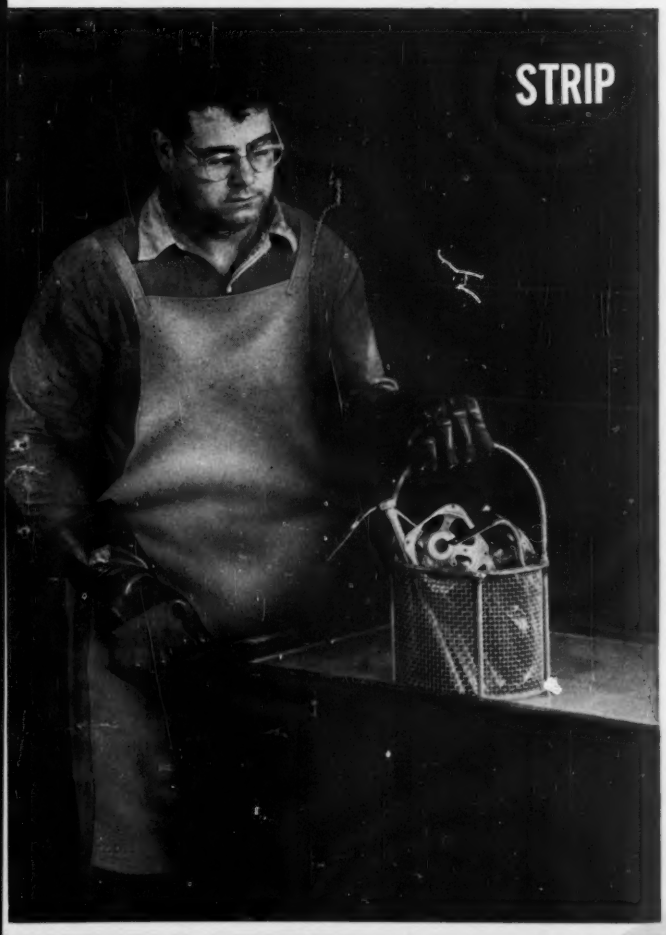
PLANTS: (4) NEW YORK, N.Y. • GRAYSBRIDGE ROAD, BROOKFIELD, CONN.



New....

A ready-to-use nickel stripper for only nickels per pound

Newly-developed Enstrip S-60 is a ready-to-use nickel stripper which costs only nickels, not dollars, per pound. And for this low price you also buy convenience, savings in labor. No electric current is required with Enstrip S-60. Just weigh it out, dissolve in water and start stripping nickel, copper, brass, zinc, cadmium or silver plate from steel, iron alloys, magnesium. The powdered alkaline compound, containing cyanide, dissolves faster than metal strippers to which cyanide eggs or bricks must be added.

S-60 can be used at room temperature and parts can be stripped overnight. Although work soaks for several hours after stripping is complete, there is no attack on most steel alloys.

For faster stripping, use the solution in the 70° - 170°F range, depending upon the metal being stripped. Brass and copper are removed at a rate of 0.0003″ per hour at 140° - 150°F and nickel coatings as rapidly as 0.002″ per hour at 140° - 170°F.

Write to Enthone, Inc., 442 Elm St., New Haven 8, Conn., for complete information about Enstrip S-60 ready-to-use nickel stripper.

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A Subsidiary of American Smelting and Refining Compa

ASARCO

To avoid copper and brass cleaning problems

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Oakite 191 gives fast, thorough action in electrocleaning brass and other copper alloys . . . simultaneously protecting against tarnish especially in reverse current tanks. Speeds removal of shop soils, smuts, light buffing compounds . . . provides an effective, non-tarnishing pre-soak for heavily contaminated parts.

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it PAYS to ask Oakite

OAKITE

over 50 Est. 1909 SCIENCE

years' leadership in industrial cleaning

METAL FINISHING is published monthly by Metals and Plastics Publications, Inc., 381 Broadway, Westwood, N. J., U.S.A.
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For better and more profitable

METAL FINISHING

RELIANCE RECTIFIERS

Standard units or specially designed to meet your individual requirements. Units can be supplied with 4 voltage ranges without current interruption.

63 *years of experience*

manufacturing RELIANCE plating and polishing equipment and supplies

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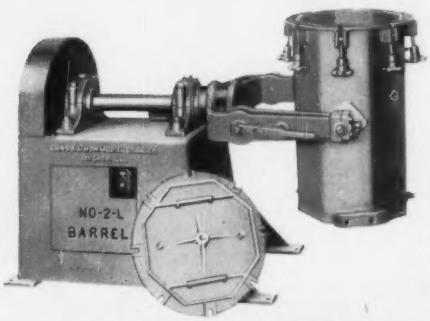
Designed to save time and labor. Cylinders constructed of warp-free Hard Rubber, Plexiglas or Bakelite. Can be loaded with motor running.



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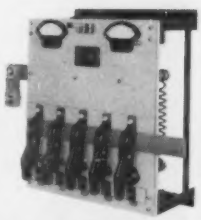
Simple and rugged construction. Self cleaning contact brushes keeps surface clean.



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THE PREMIUM BRIGHT NICKEL BATH

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There may be other baths as bright as H-VW-M Superlume

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SUPERLUME

IS THE MOST DUCTILE AT HIGHEST LEVELLING

SUPERLUME

LEVELS BEST

Sure, it costs a little more than conventional bright baths—but no more than other baths that are almost as good as fast plating Superlume. Why not get the best! Write or call for full details.

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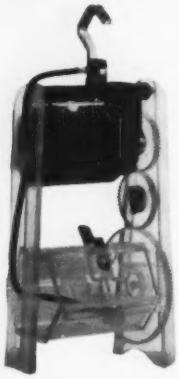
HARDWOOD LINE MFG. CO. — LAZO EQUIPMENT

SPECIALISTS IN PLASTIC PLATING BARREL DESIGNS AND FABRICATIONS

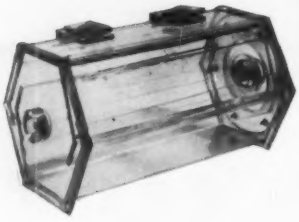
Introducing the Improved All Plastic Model 2BM Portable Barrel



MODEL 2BM

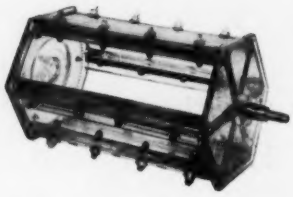
4" x 6" Cylinder Size
"Handful" Lots — Production or Experimental
Hangers Completely Plastic
More Corrosion Resistant
Hangers of Reinforcing Lucite Angles
More Rigid Precision Gear Alignment
Fewer Parts Throughout Complete Barrel
Weighs only 6½ lbs.
Overall Dimension 9" x 7" x 17" high
1/16" Perforations Standard
110V, 60 cycles, Single Phase Gearhead Motor

PLUS TWO ADDITIONAL BARRELS FOR UNUSUAL PLATING SITUATIONS



MODEL XNH

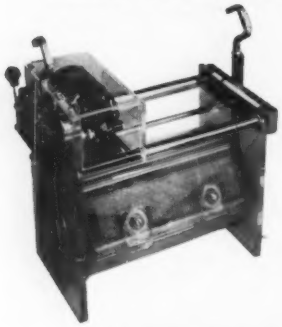
New Horizontal Slotted Solid Panel,
Non Perforated, Custom Construction



MODEL PBC

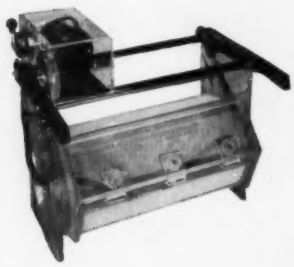
Button Type Contact Barrel
One Piece Rigid Construction
Tried and Proven
Over 7 Years in Production Operation

ALSO CONTINUING TO OFFER TWO OTHER STANDARD PORTABLES



MODEL 2BP6

6" x 12" — Cylinder Size
9" x 16" x 16" High Overall Dimension
3/32" Perforations Standard — load 15 lbs.
110V, 60 cycle, Single Phase Gearhead Motor



MODEL 2BP8

8" x 18" Cylinder Size
12" x 25" x 21" High Overall Dimension
3/32" Perforations Standard — load 30 lbs.
110V, 60 cycle, Single Phase Gearhead Motor

LARGE PRODUCTION BARRELS BELT DRIVEN OR GEAR DRIVEN

MODEL 2BSH

14" x 30" Cylinder Size
High Temperature Resistant Constructions
Motorized Barrels (Belt or Gear)
⅛" Perforations Standard—load 125 lbs.
Complete Cycle Installations

PLATING LAZO EQUIPMENT

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Originators of Ribless Plating Barrels

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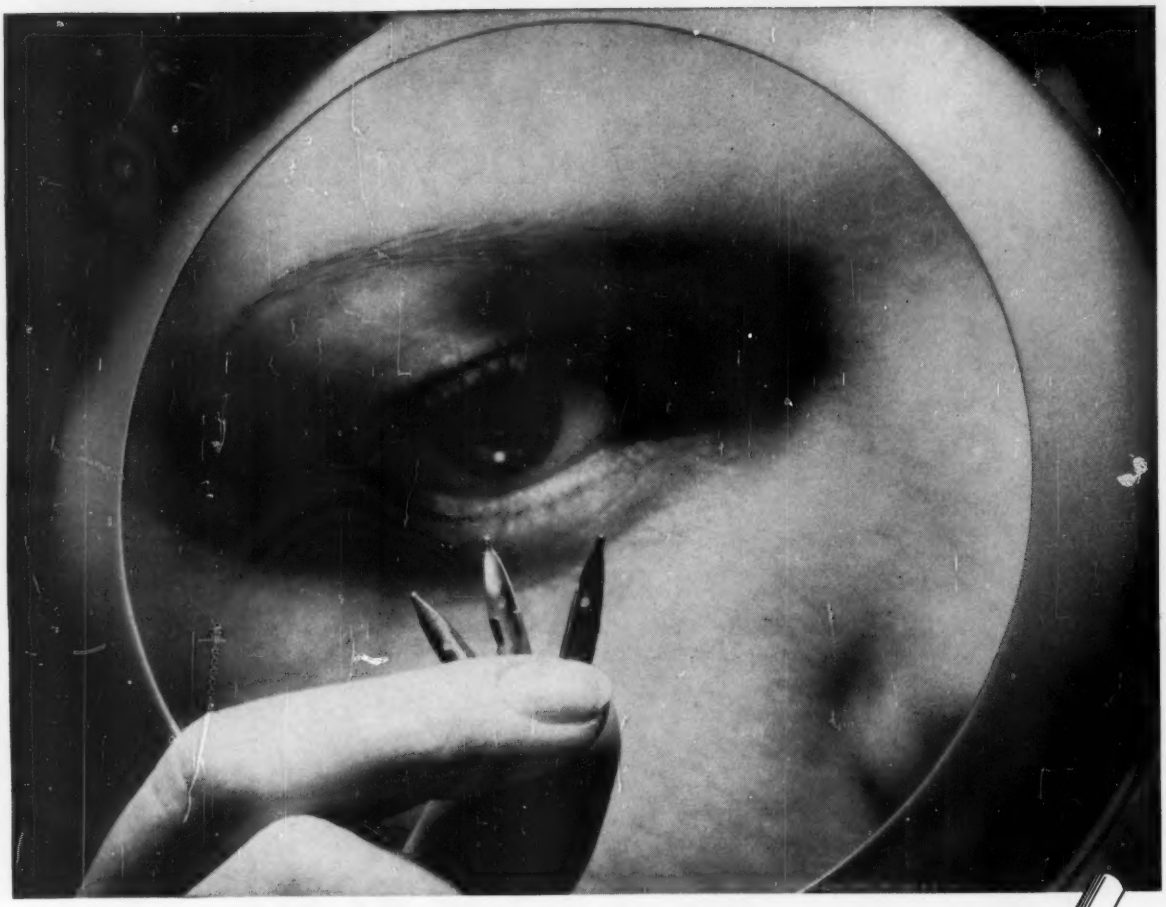


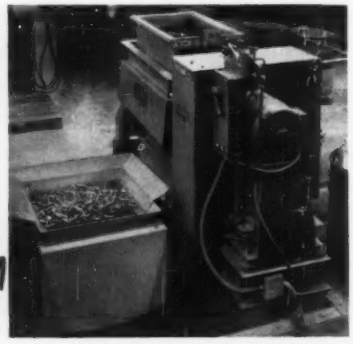
ALMCO Precision Finishing Gets to the Point.

At the Parker Pen plant in Janesville, Wisconsin, nibs for the famous Parker Pen are carefully examined (as shown). The writing surface must be flawlessly deburred and polished before being attached to the pen barrel in final assembly.

Almco precision finishing equipment does the job quickly and efficiently! Both conventional units and the new Vibratory machines are used at Parker to help make fountain pens that resist pressure, friction and abuse.

Almco's modern machines and methods—the Supersheen System—can help you achieve fine finishing results too. At Almco you receive trained counsel for your finishing problems . . . free sample processing in Almco's modern labs . . . skilled guidance in selecting the proper standard or custom-designed Almco machines and methods. Write today on your letterhead asking for an Almco sales engineer to call. Or send parts direct to Almco's lab with specs required.

Parker Pen barrels are Almco precision finished too! Almco Vibratory units can do the work 100 times faster than conventional finishing machines.



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FEDERATED METALS DIVISION

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Toronto, Ont., 1110 Birchmount Rd., Scarborough, Phone: Plymouth 73246

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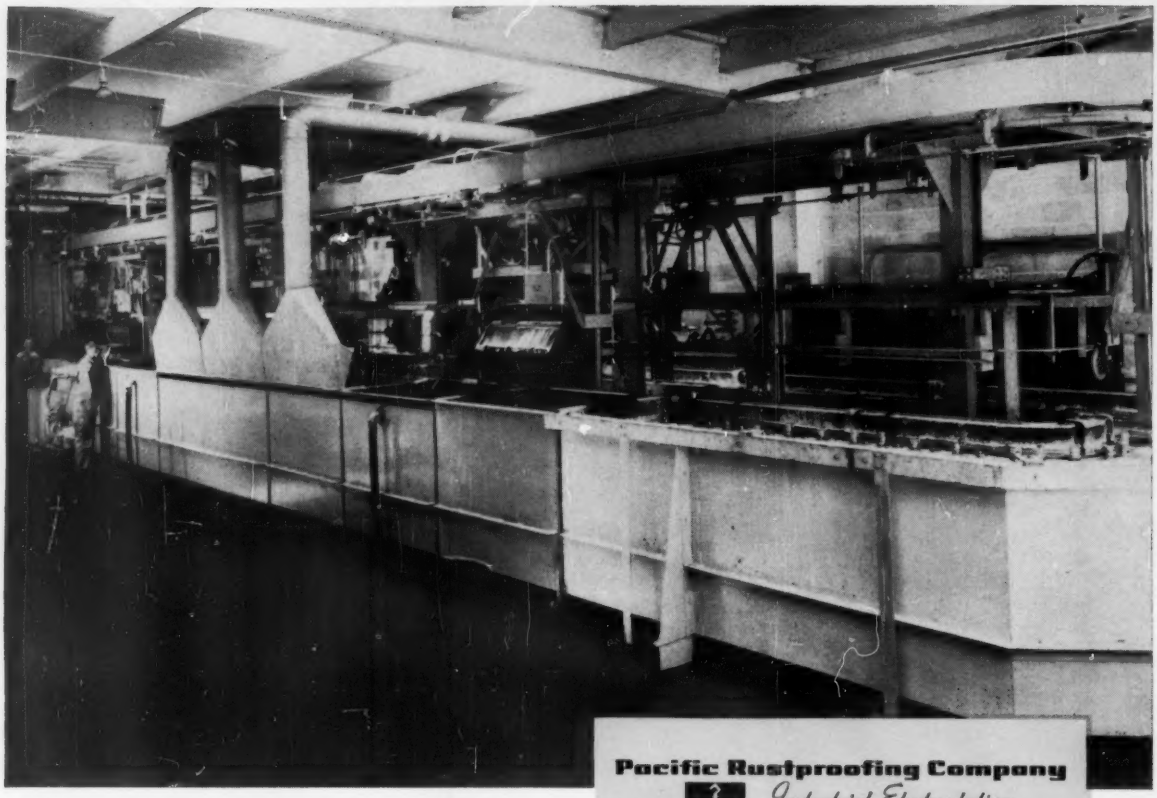

Crown "MP" gets diversified zinc plating production out on time at low cost for Pacific Rustproofing Co.

Crown MP (Multi Purpose) is the most versatile of all automatic processing equipment for meeting the output and speed demanded in modern production. The key to "MP" versatility is an ultra-modern automatic programming and control system, of far advanced design. The "MP" can process several different jobs simultaneously; for example, two or three dissimilar metals can be plated in racks or barrels at two different voltages. The "MP" handles an astonishing range of sizes and weights . . . parts from ¼ inch to 40 feet; and from fractions of an ounce in weight to tons can be processed.

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If you have a continuous dipping process, find out what Crown Automation can do for you . . . write for Bulletin "MP" today.

Pacific Rustproofing Company

Industrial Electroplating

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Pacific Rustproofing Co.

Robert M. Hart

Vice-President

CROWN

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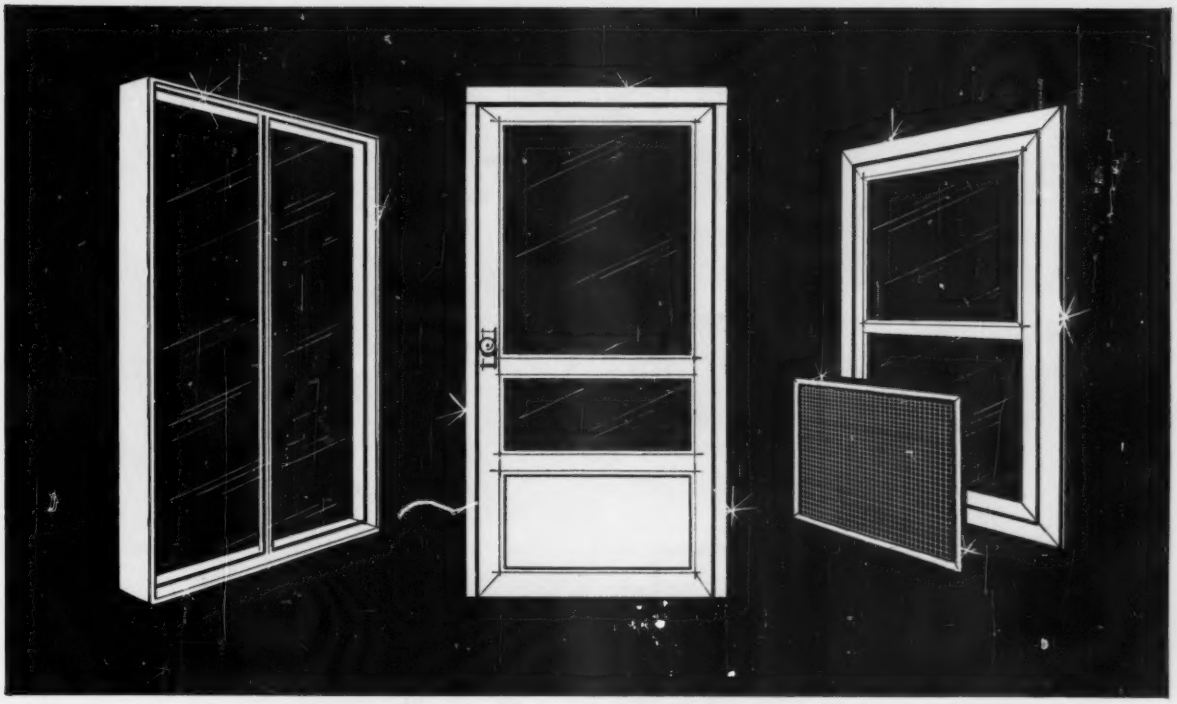

NOW... Colorless Protective BONDERITE Coating for Aluminum

BONDERITE 725 adds exceptional corrosion resistance to aluminum without changing the appearance of the metal!

This new Bonderite produces a *colorless*, amorphous oxide coating on aluminum without the use of electric current. In addition to imparting excellent corrosion resistance to aluminum, Bonderite 725 coatings are an excellent base for clear lacquer and paint finishes.

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Bonderite 725 is an efficient, economical chemical treatment applied by spray or immersion application in simple processing equipment. Processing times are as low as 5 seconds.

Up-grade the quality of your products by supplying corrosion resisting Bonderized aluminum in its pleasing natural color. You can add this sales advantage to your product at a treatment cost that will please you.

For complete information now, call or write Parker, or use coupon below.

Parker

Rust Proof Company

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BONDERITE corrosion resistant paint base • BONDERITE and BONDERLUBE aids in cold forming of metals • PARCO COMPOUND rust resistant • PARCO LUBRITE—wear resistant for friction surfaces • TROPICAL—heavy duty maintenance paints since 1883

*Bonderite, Bonderized, Bonderlube, Parco, Parco Lubrite—Reg. U.S. Pat. Off.

Parker Rust Proof Company
2167 E. Milwaukee, Detroit 11, Michigan

Please send Bulletin which describes Colorless Bonderite for Aluminum.

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Company_____

Address_____

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Now, H-VW-M takes the costly confusion out of rectifier design, by reducing *hundreds* of variations — in diodes, protective devices and controls — to *four basic models*, standardized to meet *specific* needs. You save on initial cost *and* on maintenance! Here are the four basic H-VW-M rectifier types, and some of their important features . . .

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Uses only *one* transformer, not the usual two. Result: high efficiency, lower price. And, H-VW-M has *doubled* the average control accuracy, offering *44 steps* instead of 22.

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3. The H-VW-M Anodizing Rectifier
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4. The H-VW-M General Plating Automatic Stepless Control Rectifier
Unit offers accurate control to 1% of setting. Reliable and sturdy—built to rugged steel-mill requirements for low maintenance costs.

Find out more about all four basic types of H-VW-M *Standardized* Rectifiers, offering many exclusive features and advantages – including complete protection systems. Write today to:

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Alert Supply Company is H-VW-M in the West. Los Angeles • San Francisco.

H-VW-M

Progress in metalfinishing through advanced processes • equipment

Whatever your requirements as to-

- OPERATING TEMPERATURE
- CHEMICAL RESISTANCE
- ABRASION RESISTANCE
- FREEDOM FROM CONTAMINATION

There's a "U.S." TANK LINING TO MEET YOUR MOST CRITICAL NEEDS!

Because The U. S. Stoneware Company produces a line of tank lining materials to meet virtually any operating requirement, you can be *sure* of getting a lining that will give a long, trouble-free service life . . . without paying for protection you don't need.

Among the most widely used "U. S." tank lining materials are:

TYGON® — A modified polyvinyl chloride sheeting, made by extruding rather than by calendering. Outstanding general chemical resistance up to 165° F. Non-contaminating smooth, tough, abrasion-resistant, non-aging.

PENTON* — A chlorinated polyether extruded lining, resistant to virtually all organic and inorganic agents, which fills the temperature gap between polyvinyl chloride and fluorocarbon. Withstands all inorganic acids except fuming nitric and fuming sulfuric. Physically, PENTON is tough, strong, shows outstanding dimensional stability.

KEL-F** — Trifluorochlorethylene plastic which is completely inert to corrosives of all types. Temperature range extends from –100° F. to 350° F.—higher with an acid brick oversheathing serving as a temperature gradient. Non-contaminating.

RESILON — A depolymerized rubber-and-resin-based thermoplastic available either plain or fiberglass-reinforced. Easily applied with a minimum of equipment. Suitable for a variety of mild corrosive conditions.

These and other linings produced by The U. S. Stoneware Company are installed by factory-trained, fully experienced applicators located throughout North America.

Write today for complete information on "U. S." Tank Linings.

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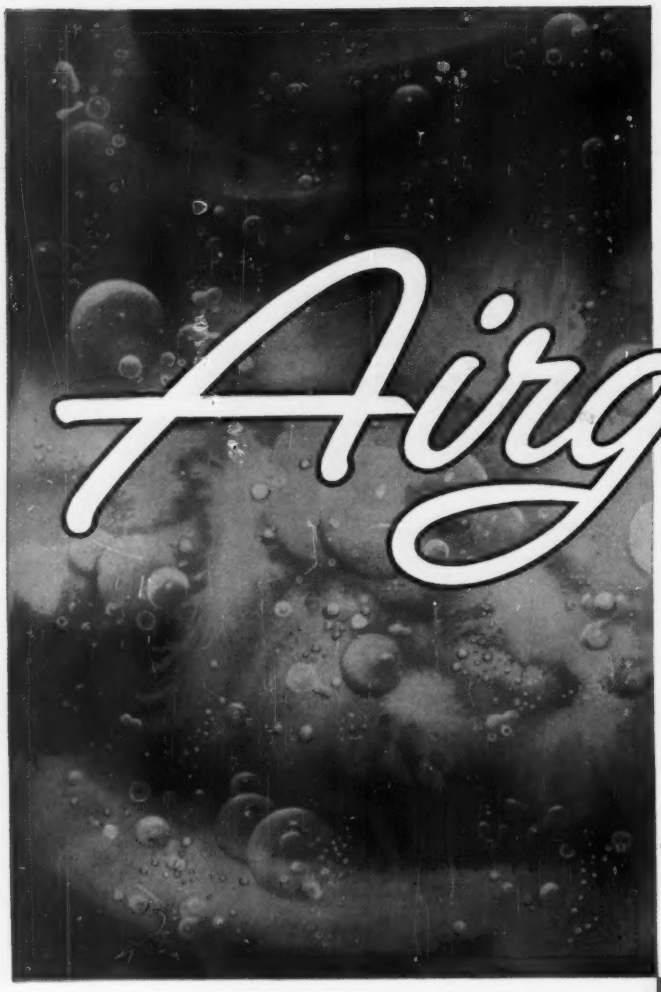
256-G

PLASTICS & SYNTHETICS DIVISION

U. S. STONEWARE
AKRON 9, OHIO



HARSHAW

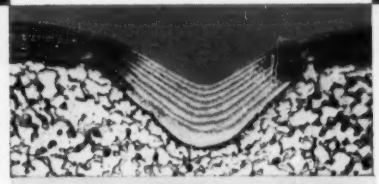
HARSHAW Airglow

AIR-AGITATED BRIGHT NICKEL PROCESS

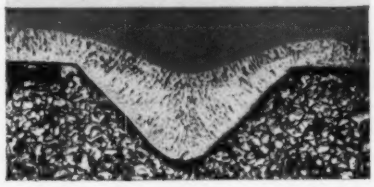
Gives you insurance against air supply failure because it operates efficiently with any agitation system.

Airglow allows the use of current densities much higher than attainable from mechanically agitated systems.

Levelling effects of Harshaw Airglow Bright Nickel deposit compared to that of Harshaw Perflow leveling semi-bright nickel.



TOP: Airglow Bright Nickel—1.5 mil deposit—depth of groove 3.1 mils.
BOTTOM: Perflow Semi-bright Nickel—1.5 mil deposit—depth of groove 3.2 mils.



- Airglow depth of color and brightness unequalled.
- Airglow corrosion resistance—the best of any bright nickel.
- Airglow gives levelling comparable to Perflow levelling!
- Airglow gives economies unusual for bright nickel.

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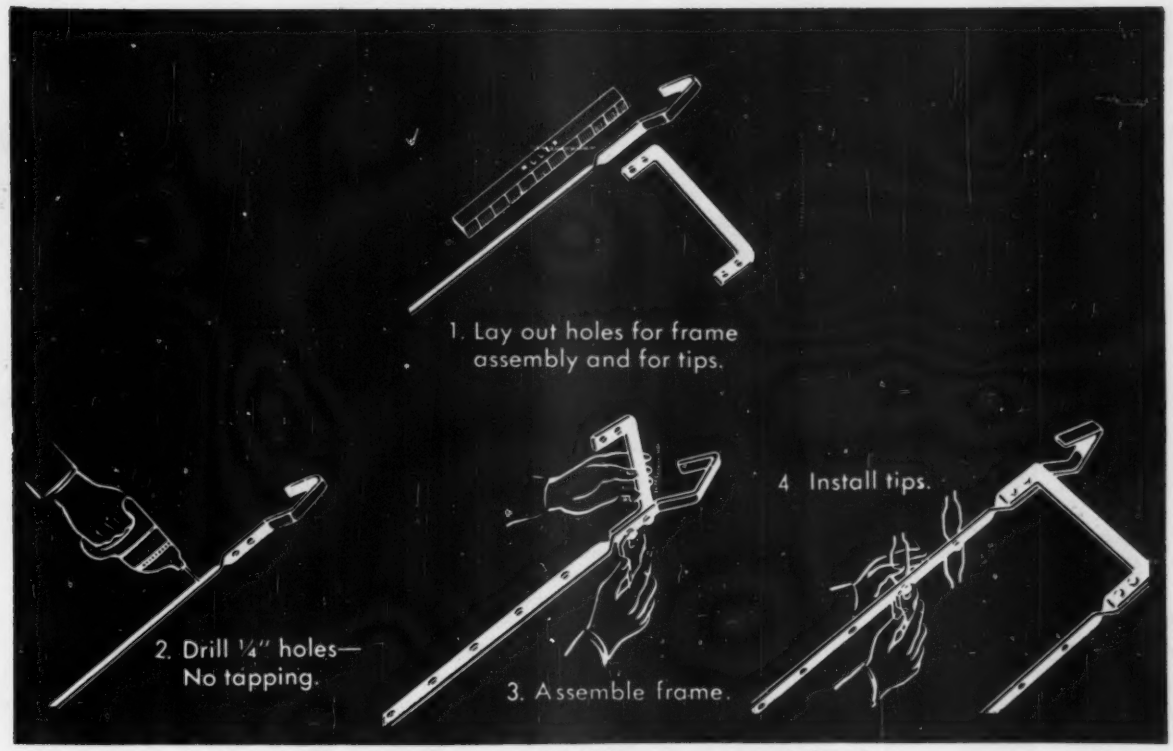

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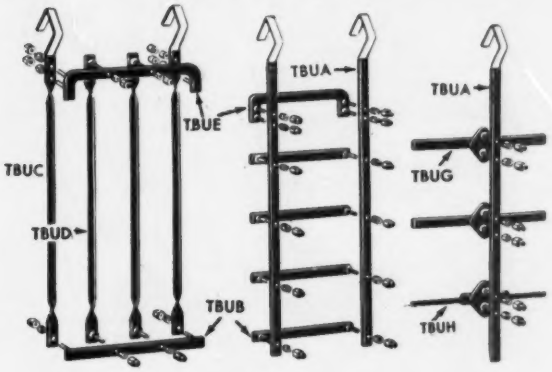

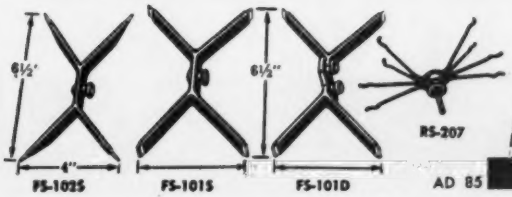

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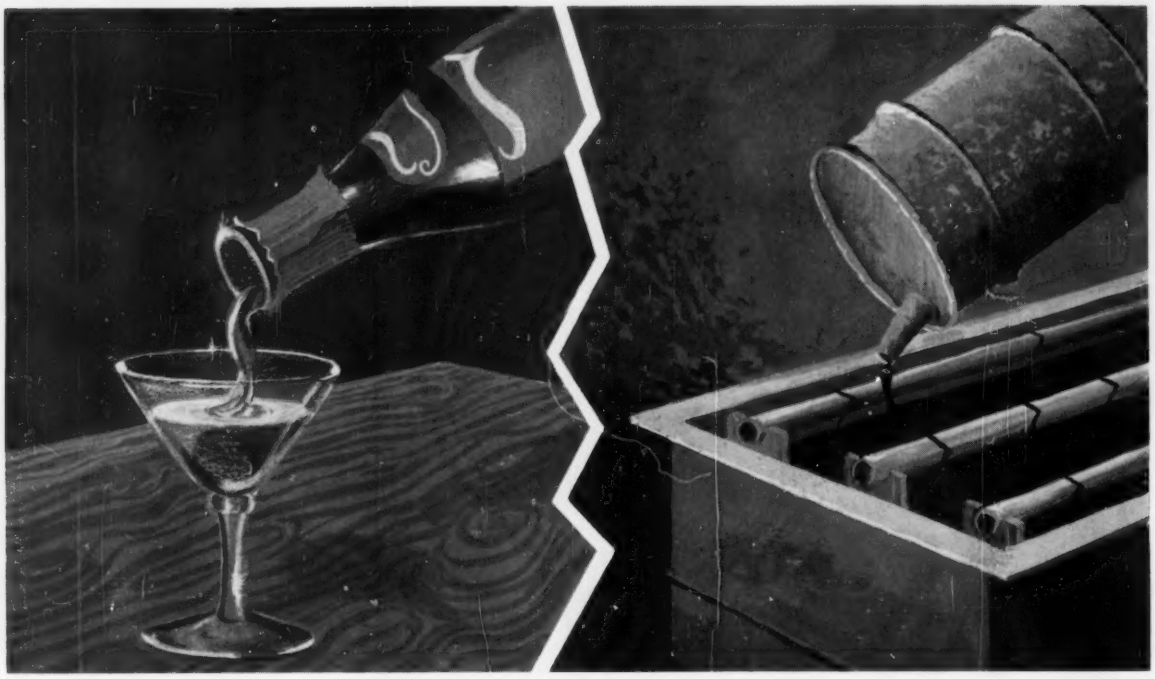

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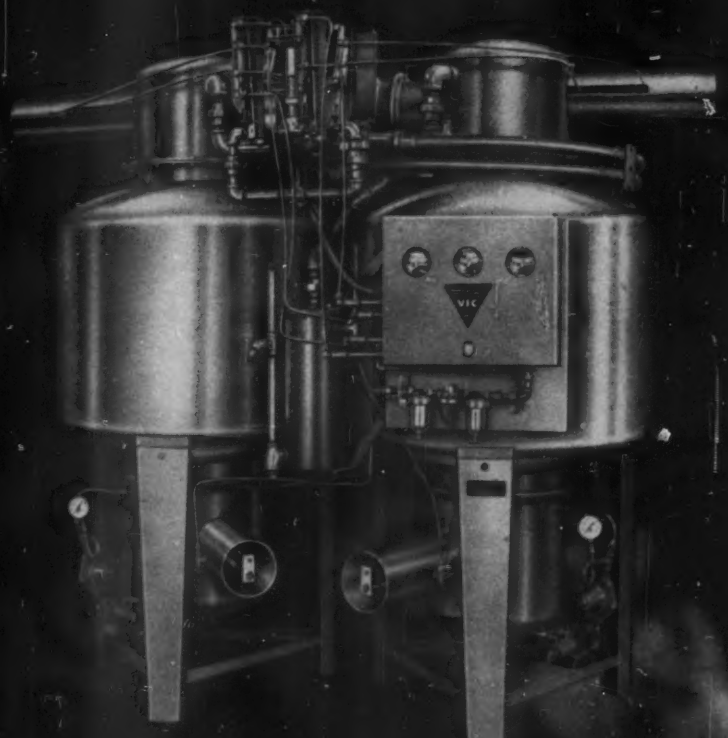

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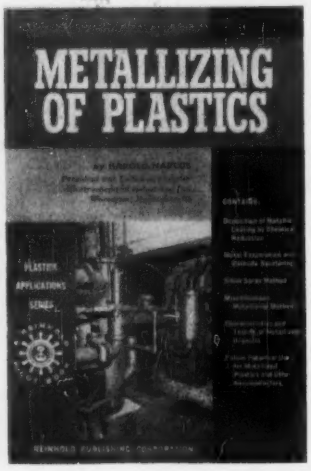

Much more than a bibliographic source, this book is essentially a metallizing manual for the plastics, electronics and electroplating industries.

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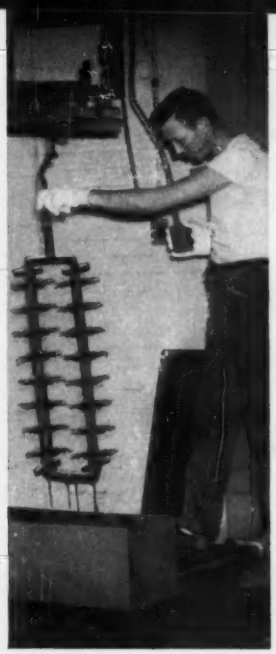

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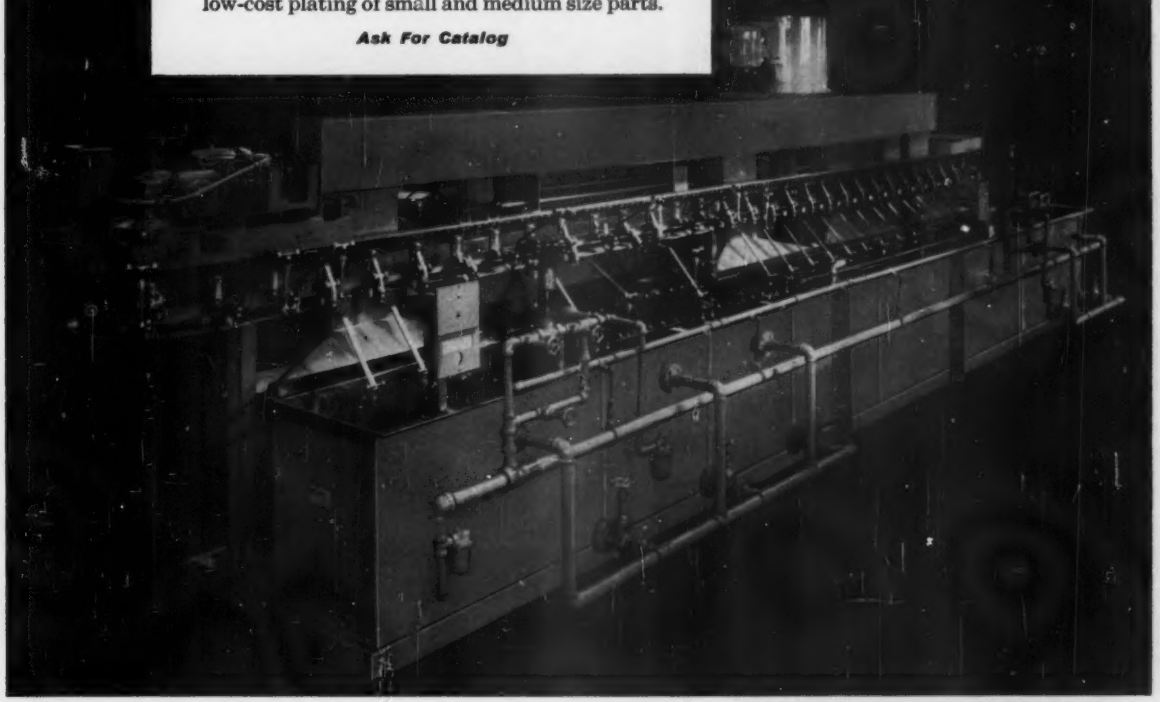

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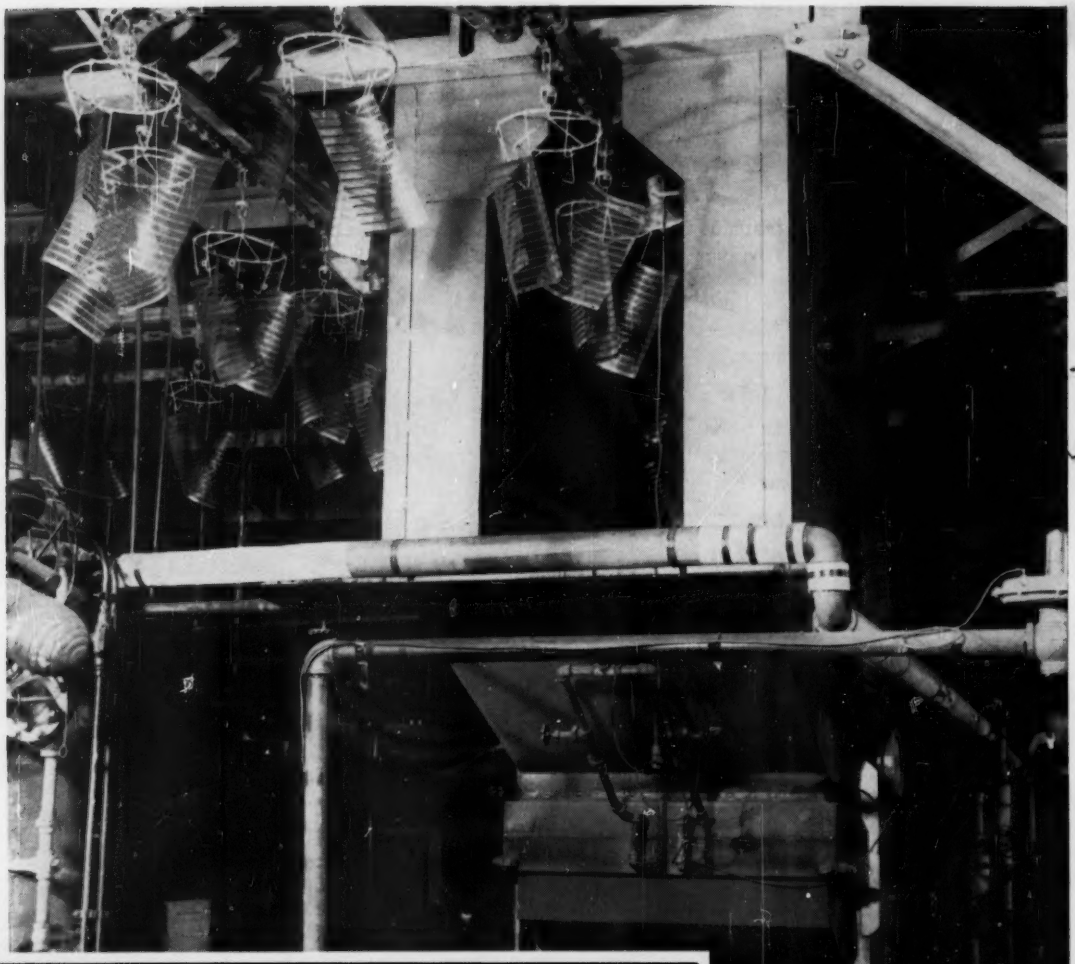
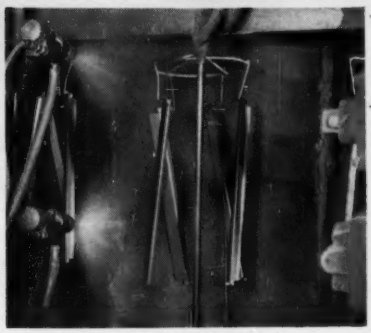


Rear grilles for Yard-Man riding mowers pass through an automatic degreasing-painting line.

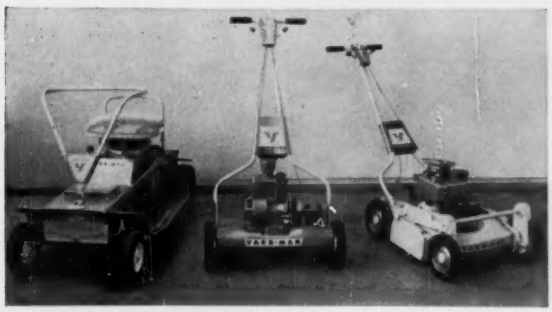
Arthur Leggett (left) Yard-Man Supervisor, plans degreasing operation with assistance of Rodger Lau, Columbia-Southern Trichlor Distributor.



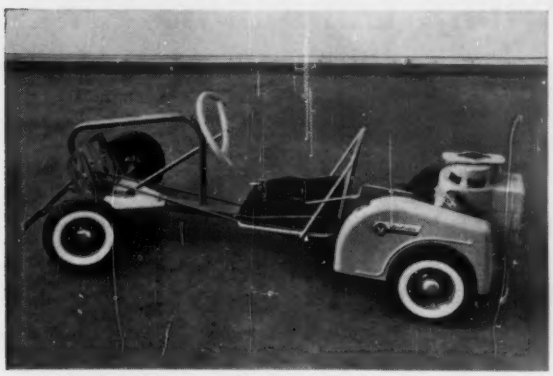
Cutter bars for reel mowers are electrostatically painted, for lasting finish.

Yard-Man selects Columbia-Southern Trichlor to assure durable, flawless finishes

The precision lawn mowers built by Yard-Man, Inc., of Jackson, Michigan, take many knocks and blows while keeping lawns trim and well clipped. And naturally they are exposed to a lot of dampness. Both of these conditions—rough handling and attack by moisture—can cause heavy damage to painted parts. To make certain paint jobs stand up well under these conditions, Yard-Man degreases parts with Columbia-Southern Trichlorethylene. That way they are sure of getting a clean metal surface that will take—and hold—a good coating of paint.



Popular Yard-Man models include (left to right) the 26 inch Riding Mower, the 21 inch Power Reel Mower, and the 22 inch Self-Propelled Rotary.



Yard-Man also makes a children's favorite—a power driven go-cart with reverse and forward drive.

A smooth coat of paint is functional as well as decorative on Yard-Man equipment. It serves as a protective layer, guarding the precision-set working parts that give Yard-Man a reputation for long-lasting, trouble-free machines. That's the reason Yard-Man painting is so important. Yard-Man has high production economy standards, too, and since many parts are painted electrostatically, in an assembly line flow, slow downs and stoppages to correct faulty work are extremely costly. Yard-Man reduces these interruptions to a minimum by running an efficient degreasing operation. And, of course, with the high production rates needed to meet demand for the quality equipment produced by Yard-Man, degreasing operations can't be interrupted often.

Yard-Man considers smart design a major sales feature, so they pay considerable attention to the styling of their units. Of course, painting is a major element in this styling scheme. That's another reason why Yard-Man insists on a good, attractive paint finish—applied to a thoroughly degreased surface.

A big factor in keeping Yard-Man's degreasing operation running smoothly is the excellent service they receive from their Columbia-Southern Trichlor distributor, Jackson Chemical Company. Yard-Man production people feel that the consultation and service supplied by the distributor are a real contribution to their work.

Yard-Man likes doing business with Columbia-Southern because Columbia-Southern Trichlor and Columbia-Southern service help keep their plant running smoothly and efficiently. You'll like doing business with Columbia-Southern, too.

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by RAYMOND B. SEYMOUR
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With a special chapter by GEORGE B. McCOMB
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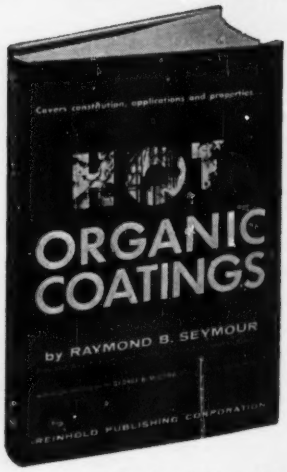
1959, 244 pages, $7.50

The constitution, applications and properties of hot organic protective coatings are concisely presented here. The book contains chapters on widely used hot organic materials such as asphalt, coal-tar pitch, petroleum waxes and cellulose derivatives. Specific information on formulations of proprietary products is included. Additional chapters deal with hot melt applications without solvent such as peel coatings, protective linings, flame spraying and the fluidized bed process. One chapter on hot applied coal tar pitch base coatings is supplied by George B. McComb, consultant to the leading suppliers of pipe line coatings. Hot spray techniques and the many advantages of this application are also covered. This book will be helpful to everyone using these coatings in any form.



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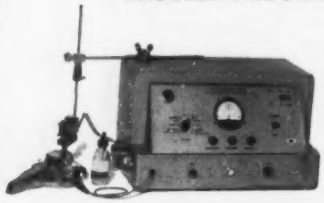

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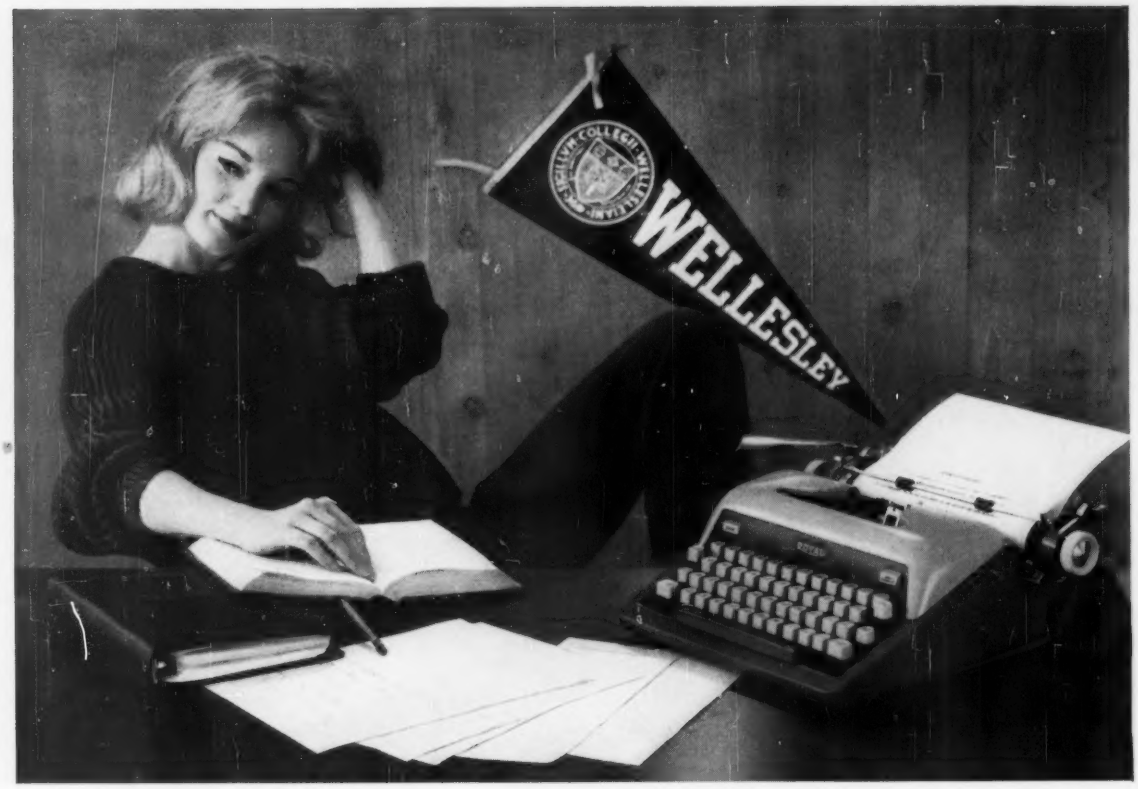

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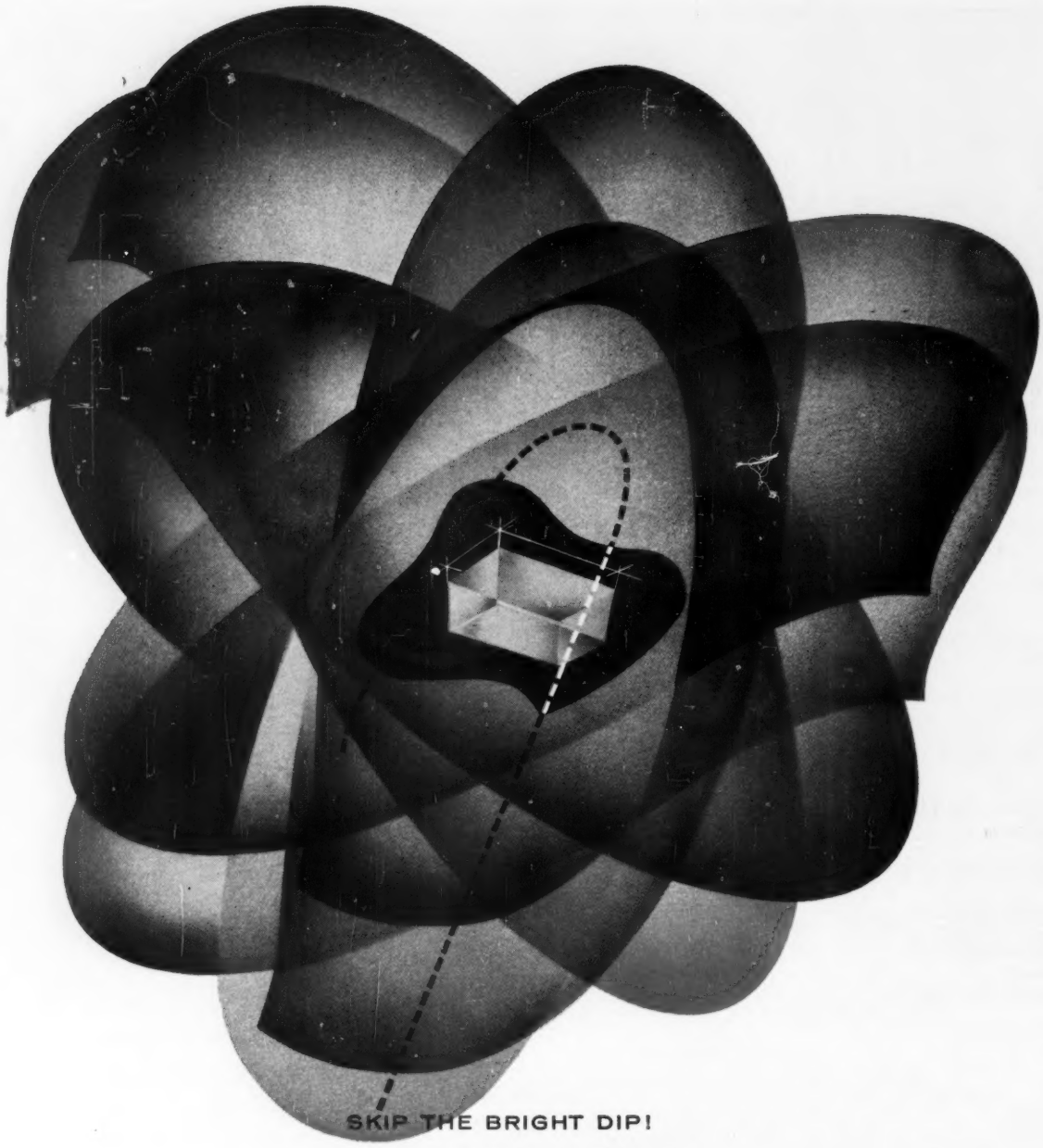

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THE OUTLOOK FOR 1961

January is the month in which editors feel duty bound to prognosticate what the immediate future holds in store for their readers. This editor considers that he is especially privileged to indulge in some forecasting because of his forbearance during the previous eleven months, when his comments were generally on matters technical rather than commercial.

The outlook at the beginning of last year was not particularly propitious, and subsequent events tended, on the whole, to confirm our less-than-happy prognostication. Toward the end of the year, even the most optimistic reports were using terms like "re-adjustment of inventories" and "consumer resistance." A few even dared to use a dirty word — recession! Steel production, the bellwether of business activity, never did go much above 50 per cent of capacity, and the decline in copper prices also indicated the absence of demand on the part of users, most of whom, acknowledgedly, have cut inventories to the bone.

Producers have been caught in a price-cost squeeze, with wage bills rising and the public beginning to rebel at the prices it has been paying, too often for goods of mediocre quality. Of course, this type of situation only accelerates the trend toward automation, so that we will not be surprised if manufacturers of automatic finishing equipment should have a fairly good year ahead. A noticeable revival of quality consciousness, already reflected in specifications for heavier copper-nickel-chromium deposits and in more durable organic finishes, is further exemplified by a twelve month guarantee on the new model automobiles.

Better finishes require greater consumption of finishing materials, which will help suppliers to some extent, even if output does not increase during the year. Despite the loss of Cuban nickel, and possibly, Congolese copper, adequate supplies should be available for any contingency. Other metals and chemicals are also in good supply and, undoubtedly, will remain so. The problem in 1961 will not be availability of supplies and raw materials, but selling the finished product to an unenthusiastic buying public.

To this observer, there seems to be a slow but definite evolution in the contract finishing field, which will eventually result in the elimination of the medium-size job shop, except for the specialty finishers, and in areas with highly diversified industries. Too large to operate profitably on a succession of very small jobs, and financially incapable of installing automatic polishing, plating, and organic finishing equipment, which would enable them to compete for volume work with the large mechanized shops, the future outlook is questionable. Of course, the tenacity for which job platers are well known, and their ingenuity in adversity could nullify the effects of this trend, but the year ahead will not be an easy one. And, the recently developed electroplating test for pregnancy does not appear to offer much of an opportunity for the employment of idle plating equipment either.

Nathaniel Hall

Technical Developments of 1960

By Nathaniel Hall, *Technical Editor*

Cleaning

EVEN ignoring the special procedures for insuring adhesion of subsequent electrodeposits, which will be surveyed in a later section of this review, the subject of cleaning received more attention in the technical literature of 1960 than in any of the last few years. This may have been at the expense of patent disclosures, however, which were relatively meager.

A rare example of *theory, as applied to cleaning*, was a paper by Graham[1] on Faraday's laws, while *practical hints* were covered by Grauer[2] in connection with simultaneous cleaning and copper plating, a process obsolete in this country but still employed in foreign lands; also, by Spencer[3] who described general *cleaning methods and descaling*. More specific were articles by Koontz, Feder & Thomas[4] on cleaning *electronic parts*, by Bullock[5] on cleaning *magnesium* with a.c. in 5-15% ammonium bifluoride to produce a stain-proof film, and by Spencer[6] on cleaning *aluminum*. Among the patents, Gulick[7] subjected ferrous metals to *high frequency induction fields* in alkali solutions containing a tertiary amino alcohol, while D'Aquila & Bohne[8] used an electrolytic *fused caustic bath* containing fluoborate. An agitated *cleaning machine* was patented by Bland,[9] and an *automatic machine* for parts in their tote pans by Sadwith.[10]

The use of *ultrasonics* which, in the finishing field, appears to be concentrated on cleaning and pickling, was treated in three articles. Steen reviewed *processes and equipment*,[11] Osterman & Santa Lucia[12] covered *cleaning and pickling*, and Obrzut[13] described how ultrasonics on a *continuous* basis could remove *smut films* from steel strip descaled by shot blasting. On the subject of blasting, incidentally, the year's developments consisted only of three patents on *abrasive blast equipment*, granted to Schulte,[14] to Leliaert,[15] and to Zieber, Brown & Wengerd.[16]

An unusual cleaning method, in which *ultrasonics* was combined with alternating higher and lower *pressures* in the fluid container, was disclosed by Logan,[17] while Schueler claimed a *basket* for small parts ultrasonically activated.[18] Other equipment was patented by Kearney,[19] and by Jacke, Newsome & Collison.[20]

Kearney was also partly responsible for other developments. With Kircher[21] he surveyed modern equipment and methods for *solvent vapor degreasing*, including solvent selection, specification, and costs, and with Nuber[22] received a patent on a *solvent-degreasing machine*. Non-flammable solvents and equipment were the subject of an article by Saxby,[23] a *diphase cleaning* system was patented by K'burg,[24] and an unusual method was described whereby the interiors of large missile tanks were degreased by vaporizing trichlorethylene in a vapor generator and *piping the vapors* into the tanks.[25]

Pickling

In contrast to the interest exhibited in cleaning, during 1960, pickling was practically ignored as a subject for investigation and report. In the three articles noted, Hudson & Stragand[26] confirmed that cold work increases *hydrogen solubility* in 1020 steel during pickling, DeCrescente et al.[27] found that the *solution rate of zirconium alloy* in nitric-hydrofluoric acid increases with concentration of the latter and with agitation, and Boyd & Galan[28] determined the amount of *thiourea inhibitor* adsorbed on steel by radiotracer techniques.

Inhibitors were patented by Saukaitis,[29] by Elbreder,[30] and by Strauss et al,[31] while Martin & Abel[32] employed a urea derivative in inhibited hydrochloric acid for removal of scale from *copper-bearing steel*, without redepositing the dissolved copper. Coleman[32A] added boron phosphate to an acid pickle as a *rust inhibitor*. Other patents consisted of an *automatic control* method for free acid and ferrous sulfate using conductivity and specific gravity, disclosed by Mancke & Shingledecker;[33] a *fused salt bath* machine for continuous strip, claimed by Shoemaker, Faler & Nolan;[34] and a fused caustic bath for *descaling titanium*, suggested by Rehner & McCullough.[35]

Polishing

MECHANICAL:

This reviewer has noted with some envy how much more attention has been given in the German literature to wheel polishing, and it was gratifying to see a developing interest in the U. S. in recent months. Progress in the field over the past 50 years was reviewed by Carlson,[36] and polishing *stainless steel* in order to obtain sanitary finishes was detailed by Waters & Corse.[37] *Belt polishing* was covered in one article, in which Weisbecker described a planned program to extend abrasive belt life;[38] and in three patents: to Welker[39] for an *endless buffing belt*, to Cosmos[40] for a *contact wheel* with interlocking sections, and to Pendergast[369] for a machine. Power brushing was covered in one article also, in which *brushes and*

machines were described,[41] and in one patent, for a machine with *abrasive feed*, claimed by Peterson.[42]

From a practical standpoint, the buff and composition are of most interest, and quite valuable from an educational standpoint was the article by Sax[43] in which the materials employed and the *construction of buffs* were described in complete detail. Tips on the employment of *buffs and compounds* efficiently were offered by Welker,[44], while *liquid buffing compositions*, progress in this field, their advantages, uses, and their application to the buff, were outlined in articles by Silman[45] and by Hatch.[46] Improvements in *buffing wheels* were disclosed in a number of patents, which will be found in the references by those interested in further investigation[47-52]. Other patents consisted of a *control* for buffing wheels and compound *applications*, claimed by Eger;[53] *work holders* devised by Eger & Piper;[54] and other equipment claimed by Rosolia & DeMauro,[55] by Winchester, Hortman & Cummins,[56] and by Rushton, Mead & Jones.[370]

CHEMICAL AND ELECTROLYTIC:

As in the previous year, 1960 evidenced widespread interest in these subjects but developments were few. The use of cyanide baths for *electropolishing gold, silver, and copper alloys* was detailed by Sullivan & Newton,[57] and two *phosphoric acid baths* were disclosed in the patent literature, one with the addition of an aromatic hydrocarbon sulfonic acid, claimed by Smith,[58] and the other with the addition of an oxyalkylene compound, developed by Swagler.[59]

Recent *trends in chemical and electropolishing* were described by Pinner,[60] while Wells[61] reviewed the *principles and practice*. And, finally, one new solution was patented, an acid fluoride *bath for aluminum* to which Kelly[62] added an organic acid, methyl cellulose, and a wetting agent.

BARREL FINISHING:

Barrel finishing is a field where, once the fundamentals have been learned, trial and error are needed to determine actual operational standards. This, of course, limits the amount of information which can be offered in the technical literature. However, for those inexperienced in the art, Enyedy[63] prepared a thorough *review of these fundamentals*, as did Mosher & Loll,[64] detailing *materials, equipment, and their efficient employment*, Forrester[65] also covered *methods and materials*, while Kohler[66] restricted his article to types of *deburring compounds* and their action.

A unique patent was granted to Madigan & Middleton[67] for the addition of pellets which could be *dissolved after tumbling* with the parts. In other patents, Lisowski et al. devised a *barrel unit*,[67A] Simjian[68] suggested abrading in a *magnetically rigidized media*, while Garwood[69] claimed a *barrel* of dodecahedron shape, Bintzler[70] a *continuous feed* apparatus, and Bakelar & Zenisek a *loading and discharging device*.[371]

Anodizing

Aside from two patents, one for a phosphate bath claimed by Beck for *anodizing titanium*,[71] and the other an alkaline borate-peroxide bath for magnesium granted to Currah, Rudin & Morf,[72] the literature — and there was not much of it considering the extensive use of anodizing — was concerned only with aluminum.

Operation of the chromic acid bath to produce films able to withstand a *240 hour salt fog test* cannot be controlled by testing the density and pH, according to Prelinger,[73] whose investigation indicated the necessity for *control of free and combined chromic acid*. For *thick coatings*, Blumenfeld & Schurig[74] found the *constant wattage method* to be more rapid than constant current, while Miller suggested the use of *pulsed currents*.[75]

On the subject of *sealing*, the increased corrosion resistance resulting from the *double process* was verified by Spooner[76] who suggested water followed by disodium phosphate-dichromate, and by Pearlstein[77] who investigated a number of *suitable combinations*. To discriminate between well and partially sealed oxide films, Cooke & Spooner[78] suggested the *sodium sulfite test*. The patent reports failed to turn up a single new sealing solution or method during 1960, which must be a record of some sort.

In two articles worthy of report, Vanden Berg[79] reviewed *coloring techniques*, and Botosan described *multicolor decoration*.[372] Three patents were granted: Cohn[80] disclosed a method of *dyeing* anodized films, Dickerson[81] developed Prussian Blue *photographic images* in the film, a subject also covered in an article by Jogarao, Indira & Shenoi[373], and Arndt & Seiler[82] treated the anodized and dyed surface with a hot solution of E.D.T.A. to form a *permanent wettable coating*. Other patents on anodizing subjects comprised a *tantalum barrel* claimed by Parsons,[83] a *power supply* devised by Mostovych & Cybriwsky,[84] and an acid bath containing a halide and aliphatic dicarboxylic acid, which Ramirez[374] claimed would produce *flexible coatings*.

Treatments for Deposit Adhesion

During 1959, so many reports were published on the problems involved in producing adherent deposits on light metals, transition metals and "exotic" alloys, that our review for that year[85] segregated them in a special section with the above title for the first time. Although the number during the year just concluded scarcely warrants this treatment, the same could be said for some of the other phases of finishing being reviewed.

Plating on aluminum was reviewed by Fitzgerald-Lee,[86] and new methods of preparation for this metal were described by Atkinson,[87] who plated *nickel directly* from a hot, low pH, sulfate-fluoborate bath, and by Ramirez & Barkman,[88] who pretreated in an ammoniacal solution of a complexing carboxylic acid prior to application of *electroless* nickel. Spooner & Seraphim[375] found a *phosphoric acid anodizing* pretreatment resulted in noticeable freedom from blistering or flaking on atmospheric exposure of nickel-chromium plate. In the single article on the other light metal, beryllium, Missel[89] described a method for producing *thermal shock-resistant* deposits.

The *amphoteric* elements were covered in three patents. Halperl[90] dipped *titanium* in hydrofluoric acid, then plated from an acid solution of nickel or cobalt

sulfate, free from halogen, while Foisel & Ellmers[91] applied an *immersion chromium* from a hot trivalent solution containing fluoride, prior to plating from a Watts bath. According to Lee & Browar,[92] *adherent nickel deposits* could be produced not only on *titanium*, but on the other elements of the group — *zirconium and hafnium* — by pickling in hydrochloric and hydrofluoric acids, containing a mild oxidizing agent, followed by electroless nickel and heat diffusion.

A common-sense approach to the problem of *activating hardenable stainless steel* for plating from the sulfamate nickel bath was employed by Scott,[93] who found immersion in an acidified portion of the solution to be very effective. Kosowsky[376] employed cathodic H_2SO_4 treatment, followed by *upward displacement of the acid by a copper sulfate solution* of higher specific gravity to apply a *copper strike*. Withers & Ritt[94] plated on *molybdenum* with the sequence of copper strike, nickel strike, gold plate, and iridium, the last from a fused bath, while Reid & Ogburn[95] improved the *adhesion of nickel on chromium* by anodically etching in acetic-sulfuric acid. And, to conclude, a valuable study of the influence of different methods of preparation on the *porosity* of electrodeposits can be credited to Clarke & Britton.[96]

Metallic Coatings

NICKEL:

In line with past experience, nickel baths and deposits were the most popular subjects in the trade and patent literature. Only one really new bath appeared, a hot, low pH, *sulfate-fluoborate* type containing a small but critical amount of chloride, which Atkinson[87] proposed for *direct plating on aluminum*. Domnikov[97] reported a Russian *accelerated nickel plating* process, including studies of the structure and properties of the deposit. Also investigated was *operation* of bright nickel solutions at *elevated temperature*, Clauss[98] finding that certain brighteners could be used above 175°F., but at a sacrifice in brightening efficiency. *Addition agents* were almost ignored, when compared with past years. Metzger, Krasley & Ogburn[99] described the use of disodium m-benzene disulfonate as a *hardening agent* in the Watts bath, Marx[100] received a patent on *coumarin derivatives* for *leveling*, and a bright process was disclosed by Strauss, et al.[101]

A number of interesting articles were published on deposits, including valuable study of the relationship between *brightness and structure* by Weil & Paquin,[102] which determined that there is no direct relationship between *preferred orientation* of crystals and brightness. Narasimham & Udupa[103] found that *cathode rotation* in a Watts bath resulted in harder and brighter deposits, while Brook[104] reported that *hardness and tensile strength* were independent of surface preparation, including in his paper a new method of measuring tensile strength of deposits. Carlin[105] demonstrated that *adhesion of organic finishes*, although poor on freshly plated nickel, is good on aged or post-treated deposits. In other articles, Chadwick described the *defects* which occur in plating on *zinc die castings*,[106] Gabrielson[107] covered the practical aspects of *automatic pH regulation*, and Beckwith[108] reviewed the development of *duplex nickel plating*.

Numerous reports on *corrosion test results* were presented during the year, many of them leaving this reporter with a vague sensation that axes were being ground. Banerjee[109] studied the corrosion of mild steel coated with *nickel of various orientations*, while comparisons of different *types of deposits* were contributed by Seyb,[110] Bigge,[111] Safranek,[112] DuRose,[113] Brown & Millage,[114] and Safranek, Miller, Hardy & Faust.[115] The contribution of nickel and chromium to the *durability of decorative plating* was described by Sample.[116]

Electroless or catalytic nickel plating came in for its share of attention in 1960, the most important development probably comprising a *stable pyrophosphate bath*, which Schwartz[117] was able to operate at appreciably lower temperature than possible with the conventional process, and offering the possibility of a wider and less expensive choice of materials of construction for the necessary equipment. Gutzeit concluded his series of articles[118] on the *chemistry of the process* and effects of ingredients, Crehan[119] described *applications for corrosion control*, and there were two *studies of hardness*, in one of which Lee[120] found that maximum hardness can be obtained by age hardening at temperatures below the 400°C. transformation point. In the other, Ziehlke, Dritt & Mahoney[121] determined that *heat treating* at 750°F. produced the greatest hardness, while at higher temperatures the deposit became softer, as it also did with lower phosphorus contents.

Among the patent grants, Gutzeit, Talmey & Lee[122] claimed a solution containing a *chelating agent*, Sullivan[123] disclosed an *alkaline solution* containing borohydride, Minjer & Brenner[124] proposed *addition of selenic acid* to increase deposition rate, and Spaulding[125] controlled the *nickel concentration* by adding an insoluble nickel compound capable of increasing the pH of the bath. *Mechanical aspects* were covered in a few more patents. Talmey & Crehan[126] claimed *continuous circulation*, with rapid cooling before filtering in order to avoid deposition in the filter, DuRose[127] suggested application of a *heat-inducing alternating current* to the work piece during plating, thus permitting maintaining the body of the bath below the plating temperature, and Carlson & Prymula[128] devised a *spray coating method* using a dual nozzle gun.

CHROMIUM:

The inseparability of nickel and chromium in decorative plating does not simplify classification in a review. It is suggested, therefore, that those interested in corrosion protection also peruse again the articles reported in the section on nickel plating.

A study of *crack-free* and nearly *pore-free* chromium deposits on *zinc base die castings* was made by Safranek, Miller & Faust,[129] with regard to corrosion protective characteristics. On the same basis metal, Jones, Carter & Edwards[130] found that accidental *variations in chromium thickness* have a much larger effect than the presence of minor defects on the surface of the coatings. Lovell, Shotwell & Boyd[131] described the results of *exposure tests* and the operation and per-

formance experience of *dual chromium* systems, Dubpernell[132] detailed the *history of chromium plating* development, and Venkatachalam & Rama Char[133] gave some *hints for job platers.*

Innovations in *chromium solutions* were found in one article, in which Safranek & Hardy[134] disclosed that a small amount of selenic acid induces *microcracking* and improved corrosion resistance. Among the patents, Johnson & Dubpernell[135] claimed a sulfate-fluosilicate, *self-regulating bath;* bright, *crack-free* deposits could be produced, according to Stareck, et al.,[136] by catalyzing the chromic acid with fluoaluminate, fluozirconate, fluotitanate, and sulfate; Andrisek & Gill used *alternating current* in various solutions as a post-treatment to produce *porous deposits*;[137] and a *spray depressant* was invented by Passal,[138] who also patented a bath catalyzed by *fluoaluminate,* fluotitanate and fluozirconate ions.[377]

We hope it isn't a portent, but three items turned up on plating the *bores of rifle barrels;* Spivak measured the *distribution of the deposit,*[139] Girard & Koetsch[140] detailed the *cycle,* which included *electropolishing the steel* bore, and Newell & Zavarella patented an *internal anode.*[141] An anode was also claimed by Dyson,[142] this one for *plating crankshafts.* Other published material on hard chromium included examples of *racking for controlled deposits,* presented by Greenwood;[143] and a survey of the *practical aspects* of the subject by Corfe.[144] Two investigations were also of interest. Suss[145] found that the use of chromium deposits on AIST 410 steel for protection against *stress corrosion cracking* in high temperature water gave anomalous results. Poor, Chessin & Alderuccio[146] determined that *honing* can cause extensive damage to metal surfaces, and other finishing operations can also affect adhesion of the deposit.

COPPER:

Very little was reported concerning the deposition of the red metal, the technical literature turning up only an article by Storey & Barnes[147] on the *growth of deposits* from the acid sulfate bath, and a series by Serota[148] on the *rochelle salt-cyanide bath* and on the *high efficiency* cyanide baths.[149] However, the patent pages were more productive. Westbrook[150] claimed *improved physical properties* from the acid bath by adding a polyoxyethanol and halogen, Abbott[151] suggested a thiourea compound plus a polyacrylamide as a *brightener,* also for acid baths, and Laue[152] employed a selenium compound with *interrupted current* in cyanide solutions, while Strauss & Willmund[153] disclosed the addition of an azide to acid solutions to prevent *sludge formation.* Sludge alleviation was also the subject of a patent granted to Van Tilburg,[154] who added a minute amount of *lithium* to an OFHC copper anode.

Electroless or catalytic copper was the subject of two patents, one to Agens[155] for a *stabilized bath,* and the other to Carlson & Prymula[156] for a *cyanide solution* containing E.D.T.A., employing hydrosulfite as the reducer.

CADMIUM — ZINC — TIN:

The question of how much onus for hydrogen embrittlement is to be placed on cadmium plating and how much on the preceding operations continued relentlessly during the past year. Gurklis, McGraw & Faust[157] indicated that, in the case of *spring steel,* pickling rather than plating is the causative factor. The authors also established *safe procedures* and the efficacy of test methods. In the case of *high-strength steel,* Geyer, Lawless & Cohen[158] found that embrittlement in cyanide and acid baths was dependent on the steel, cathode efficiency, and physical structure of the deposit. An interesting method was also proposed for *measuring loss of strength.* Suggested correctives included use of an *undercoat of nickel* from the Watts bath, evaluated by tests of Beck & Jankowsky,[159] and a number of *non-cyanide solutions* reported by Strauss & Vlannes.[160-1] Beyer[378] compared *cadmium with zinc,* showing where each would be preferred.

Not much developed in the field of *zinc plating.* Domnikov[162] reported the *effect of ultrasonics* on the elastic properties of high-strength steels to be negligible. Kohan & Francis,[163] in a study of *barrel plating carbonitrided steel,* confirmed that no deposition occurs if the carbonitriding is heavy. Excellently detailed illustrations of *rack construction* for internal and external zinc plating of steel shell cases featured an article by Bache & Robinson,[164] and a *brightener* was patented by Wernlund.[165]

Tin plating evidenced somewhat more developments than zinc last year. Thwaites examined the factors which influence *grain size of flowed electrotin,*[166] Higgs & McCarthy[167] studied the condition known as *"wood grain"* in flowed deposits, and proposed a theory that it is related to grain size and crystal structure, while Hill[168] claimed *improved solderability* after flowing, as a result of treating with dilute hydrofluoric acid.

McCarthy,[169] investigating the *oxidation characteristics* of stannous baths, determined that the *low sulfate-phenolsulfonic* acid bath showed the least oxidation. An acid *sulfate-fluoride* bath was patented by Francisco, Ressler & Ward,[170] and two *immersion tin* formulas were also disclosed, stannate-polyphosphate for *aluminum,* by Balden,[171] and acid tin sulfate with an unsubstituted polyethylene oxide for *iron,* by Streicher.[172]

ALLOYS:

The number of alloys considered in print was quite varied, although the amount of space devoted to them could not be considered extensive. *Brass and bronze* accounted for two articles each; use of the former for *rubber to metal bonding* was described by Sanghi,[173] while Cole & O'Neill[174] studied the *hardness and structural transformations,* determining that some deposits age-hardened. The two articles on *copper-tin* alloys were rather generalized and were contributed by Price[175] and by Lowenheim.[176]

In a study of *corrosion compatibility with magnesium* of coatings of various metals, it was found that tin alloys were very satisfactory.[177] *Tin-nickel* was investigated in two studies reported, Smart & Robins[178] dealing with the *structural stability* of the alloy, and Rau & Bailer[179] determining the *complexes in the*

fluoride bath. One new bath was patented by Taylor & Phillips,[180] an *acidchloride* type. Couch & Connor[181] were unsuccessful in their attempts to codeposit *aluminum and nickel* and produced such alloys by plating the individual metals and heat diffusing. Rama Char & Panikkar[380] described *pyrophosphate baths for nickel-zinc alloys.*

The *magnetic properties of cobalt-nickel* alloys were studied by Zentner,[182] Steiger[379] reported Russian research and development in the same alloys, while Tsu tested deposits of *iron-nickel* produced in chloride baths.[183] Small amounts of certain addition agents were found by Sallo & Fisher to prevent codeposition of *tungsten with iron, nickel, or cobalt*[184] and, in the patent grants, a *gallium-indium* alloy from glycerol baths was claimed by Zimmerman,[185] while *chromium-iron* was the subject of two patents, a sulfamate bath disclosed by Schaer[186], and a trivalent chromium-urea bath by Nitto.[187]

MISCELLANEOUS METALS:

Aside from one article on *silver,* in which Geld[188] described an *immersion nitrate-iodide process* for electrical contacts, and one on *bright, heavy deposits of platinum* from a sulfato-dinitritoplatinous acid bath, presented by Hopkin & Wilson,[189] the subject of *gold plating* preempted the precious metal field. Ostrow & Nobel[190] compared the *physical characteristics* of deposits from different baths, Harding[191] determined that, for *tarnish resistance over silver,* a minimum of 0.0004″ is required from cyanide gold baths, and Ehrhardt[192] described an exceptionally *pore-free plating process* using an acid citrate bath developed for printed circuits. A cyanide gold bath containing *Turkey Red oil* for heavy deposits was reported by Seegmiller,[193] while Mohrnheim[194] suggested the chemical reactions occurring during preparation of the *yellow prussiate* gold bath. Dingledein[381] described the close control needed to give reproducible results in *plating selected areas.*

Plating of a variety of metals from *fluoborate* solutions was surveyed by Wild,[195] listing formulas and operating conditions, while Barrett[196] did the same for *sulfamate baths,* including nickel, cobalt, iron, cadmium, and cobalt-nickel alloys. Kappanna & Talaty[197] reviewed *fluoride* baths, and Sree & Rama Char[198] covered *pyrophosphate* solutions for cobalt and iron. Miscellaneous developments disclosed in the patents comprised a *fatty acid bath for aluminum,* claimed by Schickner;[199] an *alkaline glycerine bath for molybdenum,* developed by Wernlund;[200] a solution of nitrates in absolute alcohol for *neptunium and lanthanum;* devised by Seaborg & Wahl;[201] and a fluoride bath, which Wehrmann claimed suitable for *polonium.*[202]

Electroforming — Metalizing — Vapor Coating

Interest in metalizing and electroforming was rather moderate during the past year, as compared to the previous one. This held true in all phases of the field and, with few exceptions, the technical developments were the subjects of patent claims. Pierce[203] patented a *method of metalizing* with a *graphite film and iron powder* followed by immersion copper, which should bring back memories for habitués of the old electrotype foundries. A *silver mirror* coating could be produced on non-conductors by applying aqueous solutions of polyvinyl alcohol and a silver salt, followed by heating to reduce the silver, according to Schaefer,[204] and a *spray method* was claimed by Weinrich[382]. *Production of sheet* on rotating drums was treated in an article by Carrington,[205] and in a patent issued to Yeck,[206] while a *hollow mold for boots* was claimed by Bingham.[207]

Printed circuit production appeared in one article, a survey by Eisler.[208] A number of improvements in the art appeared in the patent grants, however, with regards to *plating methods.* These were disclosed by Deer[209] on *masking,* by Lee[210] on *copper-coated electroless nickel,* and by Langton on electroless copper for *plating through holes.*[211] Bain & Geshner claimed a method using *gold plate as an etch resist,*[212] and Ritt & Sayers a method of plating at least *two different metals;*[213] another method was detailed by Lyman;[383] while McGraw[214] employed *vacuum metalizing* techniques.

Vacuum coating was also the subject of other patents and reports. Clough & Farrow[215] pointed out the advantages of *thick aluminum and cadmium coatings* for protecting steel without hydrogen embrittlement, and Williams[216] outlined results of tests on production of *thick cadmium deposits.* Shepard[217] patented a method of applying *aluminum films on iron,* and Toohig[218] increased the thickness of flat *metal screen of fine mesh* by depositing metal in a vacuum chamber. Other patents included a *cathode sputtering* apparatus, claimed by Kuhlman,[219] equipment invented by Scatchard,[220] and by Schwindt,[221] the latter for *continuous strip.*

In the field of *gas plating,* Powell[222] described the process, its advantages, and drawbacks, Owen detailed equipment and process variables in the *nickel carbonyl* technique,[223] and Wlodek & Wulff investigated *molybdenum* coating adhesion.[224] *Chromium diffusion* processes (chromizing) were patented by Dorner,[225] by Samuel & Bell,[226] and by Samuel, Bell & Jackson,[384] and two were granted on *aluminum* coating, one to Berger[227] who used an *aluminum-organo* compound, and the other to Breining, Bolton & Deutscher[228] for an *alkyl* compound. Nachtman & Bjorksten[229] were credited with a novel *application method,* which involved impinging a flame of *burning metal carbonyl* on the preheated surface, and the use of a *silicone grease as a masking agent* was disclosed by Bolton.[230]

Conversion Films — Corrosion Preventives

In the old days it was relatively simple to categorize conversion coating processes — they were either phosphate or chromate types. It is somewhat more difficult these days when almost everything but the kitchen sink, it would seem, is added. *Basic concepts* were explained by Ayres,[231] and *processes for zinc and aluminum* were surveyed by Freeman & Triggle,[232] these authors covering the general fields.

Of the processes involving the use of *chromates,* in particular, very little appeared during 1960. Spencer[233] and Ostrander[234] presented reviews, the former

describing *film characteristics*. A bleached film, chromate process for *aluminum* was patented by Pimbley[235] and improved baths for this same metal were disclosed by Russell & Van Vliet,[236] who claimed a solution of *phosphate, chromate, fluoride and aluminum ions*, and by Newhard & Dollman,[237] who also claimed a bath of the above constituents, except the aluminum ions. Pimbley also received a grant on a solution of a *metal salt, chromate and a halogen*.[238] Zinc nitrate-chromic acid baths for *zinc* were offered by Francis & Roebuck.[237A] New baths for *magnesium* included chromate, chloride, and nitrate, developed by Heller,[239] and a *double dip process* claimed by Kapfer & Kronstein.[240]

Processes based on *phosphate* were disclosed only in the patents, except for a method of reducing the *galling tendency of titanium* by producing an anodic coating, described by Pray, Miller & Jefferys.[241] Another anodic treatment, for *black plate*, was claimed by Smith & Smith.[242] *Phosphate dips* were patented by Swalm & Spring,[243] and by Blaser & Mayer,[244] while Hyams[245] followed the phosphating treatment of iron by a *non-oxidizing acid rinse*, prior to the usual chromate rinse. A *zinc orthophosphate* method was claimed by Drysdale & Burton[246] for zinc and cadmium, as well as for iron. In other patents, Neilson[247] developed *equipment* for phosphating, and Bengtsson & Olsson[248] coated *stainless steel* at elevated temperature and pressure in a mixture of phosphoric and nitric acids.

Oxide coatings were described by Spencer,[249] an inorganic-organic process was patented by McDonald,[250] and patents were also granted on methods for specific metals. These included one for *iron* obtained by Morris & Lombardo,[251] an oxalate borate-sulfide bath for *nickel alloys and stainless steel*, disclosed by Otto,[252] and an acid fluoride bath for *zirconium*, devised by Jenkins, Freeman & King.[253] Coating methods for *titanium* were claimed by Shaw & Ness,[254] who disclosed an acid solution of ferric, oxalate, and fluoride ions, and by Lipinski,[255] who used a nitrosulfonic acid solution with fluoride to improve *paint bonds*. Lipinski also employed the same acid without fluoride for *aluminum*.

One new method of protection employing *volatile corrosion inhibitors* turned up, in a patent for an impregnated wrapping paper issued to Ennis.[256] For those interested in *hydrocarbon-type* protective films, references to the relevant patents are appended.[257-66]

Testing and Control

Articles on testing and control showed greater interest in the deposit than in the solution, in contrast with the previous year, when the honors were about equally divided. Two methods were proposed for *sulfate in chromium baths*, one by Emery[267] consisting of a *combustion method* similar to that used for sulfur in steel, and the other by McKinley & Jones[268] involving *reduction of the sulfate to sulfide*. Branciaroli[268A] detailed methods for *chromic acid, sulfate, and fluoride*. Rapid and accurate *spectrometric* determination of *nickel, copper, silver and gold* in plating solutions, employing an *x-ray fluorescence method*, was described by Bertin, Longobucco & Fitzgerald,[269] while Knotowicz & Tatoian[270] detailed a *polarigraphic procedure* for *gold and gold alloys*. Other specific methods included a new, stable *indicator for EDTA titrations*, suggested by Lindstrom & Diehl,[271] and a procedure for sulfuric acid *pickling inhibitors*, by Bertzog.[272]

The analysis of *copper cyanide baths* was surveyed by Serota,[273] while *free cyanide* in these baths was investigated by Crain,[274] who confirmed the high results caused by dilution and by increase in sample temperature, and by Gabrielson, who determined that *ion-exchange methods* were unsuitable.[274A] Steinmetz[275] applied *statistical analysis* to bath and deposit control, Duffek[385] showed how *solution control* was affected by *current efficiency*, and Mohler indicated the possibility of control of solutions by *specific gravity*,[276] and the control of *bath limits*.[277] The same author also described the use of the *vertical slot cell*.[278] In the only other article dealing with test cells, Watson used the Hull cell for measuring *throwing power* in terms of deposit thickness,[279] at the same time studying the effects of *additions to nickel baths*.

Data on *corrosion resistance* of plated *zinc die castings* were offered by Safranek et al,[280] and by Caldwell & Sperry.[281] Correlation of *outdoor exposure service and accelerated tests* was investigated by Saltonstall & Millage,[282] and by Thomas, Hardesty & Nixon,[283] who described a method of preparing *uniform and reproducible deposits*. This last development, at least, will eliminate one of the twenty variables which Frank[284] listed for the *salt spray test*. An *electrographic* printing method for evaluating *porosity and cracking* of deposits was developed by Miller & Friedl.[285] *Sulfur*, which is considered to decrease corrosion resistance when incorporated in nickel deposits, was analyzed by Rogers, Ware & Fellows.[286] Using *thiourea as a brightener and leveler*, they employed *radiotracer techniques* for the determinations.

Deposit *adhesion* was surveyed by Serota,[287] *abrasion resistance* of coatings accounted for an improved *abrasive jet tester* described by Roberts,[288] and a *cup test* was employed by Romanoff[289] to determine the *fabricating qualities of preplated metals*. Newell[386] surveyed *stress in deposits*, its theory and measurement. Instruments for measuring *luster, brightness*, and *smoothness* were described by Quarendon,[290] while Cotton[291] dealt with *static loading tests* for delayed brittle fracture of high strength steel due to *hydrogen embrittlement*. Since the usual *dye test* shows only whether anodized aluminum has been sealed, not whether it was sealed properly, Hoar & Wood[292] employed a method for determining the *degree of sealing* which involved post-sealing in dichromate, dissolving the film in caustic soda and measuring the amount of adsorbed chromate colorimetrically.

Wide interest in *thickness testing* probably should be one of the best indications of increasing concern with plating quality, but this was not confirmed in the literature. Wilson[293] discussed the precautions necessary for accurate thickness and hardness testing of *gold deposits*, Mathur described a precision instrument for the *electrolytic stripping method* of thickness testing,[294] and Lamb & Krasley[295] a gauge for chromium on the *internal surfaces of small bore tubes*. *X-ray methods* were covered in articles by Zimmerman,[296]

and by Cook, Mellish & Payne.[297] *Electronic methods* were disclosed in an article by Kriegler & Schumacher,[298] and in patents granted to Lieber,[299] and to Hanysz, Quinn & Weller.[300]

Waste Treatment

For waste treatment, as in the case of thickness testing, the popularity of a subject in the literature appears to bear no relation to its importance and extent of employment in industry. A few articles are reported in other sections of this review, but the sum total is still far below par, if we compare it with previous years.

Greenberg described how treatment can be *integrated* into the *processing line*,[301] while *installations* were detailed by Robinson,[302] by Fair,[303] and by Druschel, Zievers & Zabban,[304] the last including both *batch and continuous* treatment. Control of *chromate wastes* using oxidation-reduction potentials was covered by Hulse, Selm & Summers,[305] and *metals in wastes* could be checked *spectrographically*, according to another article.[306] *Pickling wastes* were the subject of three patents. Cooper[307] produced iron carbonate and ammonium sulfate, while *regeneration of spent sulfuric acid* was disclosed by Francis,[308] and by Sweet, Wolbach, Jr. & Sugino,[309] who added concentrated acid to the pickle liquor after evaporation, in order to precipitate the ferrous sulfate.

Miscellaneous

More was published *on barrel plating* during 1960 than in the past five years taken together. *Solution transfer* in this type of plating was investigated by Glab, Modjeska & Gary,[310] and LaManna,[311] detailed the *theory, equipment, operating techniques, and solutions* for all the commonly deposited metals. *Size control of plated screws* was considered by Pollack,[312] while Field prepared *nomographs* for measuring *loads and areas*.[313] Among the inventors, Jenks & Niles[314] claimed a novel *cylinder construction*, Bell[315] a *miniature barrel*, Jackson[316] a cylinder with an *automatic* door panel, and Hoegh[317] eliminated the door panel entirely. Automatic *barrel platers* were patented by Round[318] and by Barton.[319]

In the single article on *automatic rack processing* equipment, Saxby[320] discussed their operation, while a number of patents were granted on improved machines.[321-8] A continuous plater for *glass sheets* was patented by Gray,[329] a machine with *auxiliary anodes* was claimed by Borodin,[330] and a *semi-automatic, oscillating* unit by the same inventor.[331] Also, in the way of equipment, Davis[332] disclosed an *anode shifting device*, Allison[333] showed a method of *plating bearing shells* on one side, and Pyles devised an apparatus for plating bearing surfaces of *crankshafts*.[334] A *roll for strip plating* units was developed by Smith,[335] and *plating racks* were improved by Nali[336] and by Villette.[337]

On matters electrical, Cheffers described a practical method of calculating *area* by measuring *plating tank resistance*,[338] Darrah drew up *oscilloscope patterns* specific for different *conditions of rectifiers*,[339] Bartholomew[339A] reviewed past and present *developments in rectifiers*, and Hartley[340] discussed *electrical connections* and *current leaks*. A *contact for wire and strip* plating was patented by Roy & Sallo,[341] and another grant was made to Hausner for a *superimposed a.c.* method of plating.[342]

Discussions about *hydrogen embrittlement* usually suggest to this reviewer the analogy of discussions about the weather, but a symposium on the subject last Summer pointed up the great strides which have been made in recognizing the *causes and symptoms*, a prerequisite for the development of future cures. Read discussed the *metallurgical aspects;*[343] Barton the *mechanism of hydrogen transport* across solution-metal interfaces;[344] Hill[345] described the *behavior of hydrogen* in iron and steel; Lawrence[346] the *detection and control* of chemisorbed hydrogen during electrolysis; and Snavely described the *methods of measuring* hydrogen embrittlement.[347] Readers will also find other references to the subject scattered through this review of the year's technical developments.

Coloring of metals accounted for one article, in which Schore[348] gave *typical formulations*, and three patents, to Mason for an *acid copper-tellurate* bath,[349] to Bongartz & Beigay[350] for an *anodic treatment for stainless steel* in alkali metal hydroxide, and to Mitchell[351] for the addition of a sulfur-containing organic compound to a *conventional blackening bath* to prevent *smut formation*. There were also two patents issued on *stripping*, in one of which Weisberg & Butler[352] used a nitro-substituted aromatic compound and amine to remove *nickel deposits*, and the other for a bath of fuming nitric plus hydrofluoric acid, which Sherwood & Hoyt[353] claimed to be suitable for removal of *electroless nickel*.

Other miscellaneous items culled from the literature included *plant descriptions* by Rain & Self,[354] and by Wood.[355] Ananiatis[356] detailed some practical observations concerning *plating on buffed zinc die castings*, while Fitzgerald-Lee[357] surveyed chemical and electrochemical *protective treatments for magnesium alloys. Production methods* were claimed in three patents, to Lancy for *plating metal strip continuously*,[358] to Luechauer[359] for *continuously plating bearing shells*, and to Hendee, Brown & Fine[360] for *deposition of rare metals*.

Other subjects considered were *cost estimating procedures* in a job shop, by Coombes;[360A] the determination of *rinsing requirements* by application of basic principles, reported by Parker;[361] *corrosion-resistant cements* and their application, reviewed by Evans;[362] *hazards* in the plating room, described by Meyer;[363] *steam heating*, by Saxby;[364] and a tour of European plants, reported by Marino.[365] Among the patents could be cited a *universal brightener* prepared from dehydrated okra pod extract by *Robinson*,[366] a P.V.C. laminate *tank lining* developed by Korn et al.[367] and an electrically-heated *wall for salt spray chambers* disclosed by Seidman.[368]

A not-insignificant crop of "pseudo scientific" articles has not been included in this review because it does not take much ingenuity to prove Proprietary Product or Process X is superior to a conventional one if the investigator is at all discriminating in his choice of a basis for comparison.

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73. H. A. Prelinger. Metal Finishing, **58**, 59 (Nov.).
74. M. A. Blumenfeld & W. F. Schurig. Plating, **47**, 1159.
75. M. A. Miller. U.S. Pat. #2,920,018 (Jan. 5).
76. R. C. Spooner. Chem. in Canada, **12**, 92 (Apr.).
77. F. Pearlstein. Metal Finishing, **58**, 40 (Aug.).
78. W. E. Cooke & R. C. Spooner. Metal Finishing, **58**, 83 (July).
79. R. V. Vanden Berg. Prod. Fin., **24**, 24 (Feb.); 32 (Mar.).
80. C. C. Cohn. U.S. Pat. #2,927,872 (Mar. 8).
81. M. H. Dickerson. U.S. Pat. #2,935,403 (May 3).
82. H. Arndt & H. Seiler. U.S. Pat. #2,924,539 (Feb. 9).
83. C. H. Parsons. U.S. Pat. #2,933,443 (Apr. 19).
84. N. Mostovych & A. Cybriwsky. U.S. Pat. #2,951,025 (Aug. 30).
85. N. Hall. Metal Finishing, **58**, 42 (Jan.).
86. G. Fitzgerald-Lee. Prod. Fin. (Br.), **13**, 74 (Feb.); 84 (Mar.).
87. J. T. Atkinson. Plating, **47**, 509.
88. E. R. Ramirez & E. F. Barkman. U.S. Pat. #2,958,610 (Nov. 1).
89. L. Missel. Metal Finishing, **58**, 53 (Mar.).
90. D. Halpert. U.S. Pat. #2,921,888 (Jan. 19).
91. W. J. Foisel & C. R. Ellmers. U.S. Pat. #2,946,728 (July 26).
92. W. G. Lee & E. Browar. U.S. Pat. #2,928,757 (Mar. 15).
93. B. E. Scott. Metal Finishing, **58**, 48 (Nov.).
94. J. C. Withers & P. E. Ritt, Jr. U.S. Pat. #2,929,766 (Mar. 22).
95. W. E. Reid, Jr. & F. Ogburn. J. Electrochem. Soc., **107**, 91.
96. M. Clarke & S. C. Britton. Trans. Inst. Met. Fin., **37**, 110.
97. L. Domnikov. Metal Finishing, **58**, 44 (Mar.).
98. R. J. Clauss. Proc. A.E.S., **47**, 105.
99. W. H. Metzger. Jr., P. A. Krasley & F. Ogburn. Plating, **47**, 285.
100. U. F. Marx. U.S. Pat. #2,961,386 (Nov. 22).
101. W. Strauss, A. Kirstahler, W. Gundel & H. Haas. U.S. Pat. #2,937,978 (May 24).
102. R. Weil & R. Paquin. J. Electrochem. Soc., **107**, 87.
103. K. C. Narasimham & H. V. Udupa. Electropl., India, **2**, 9.
104. P. A. Brook. Plating, **47**, 1269.
105. F. X. Carlin. Proc. A.E.S., **47**, 59.
106. J. Chadwick. Electroplating, **13**, 239.
107. G. Gabrielson. Metal Fin. J. (Br.), **6**, 239.
108. H. M. Beckwith. Plating, **47**. 402.
109. C. Banerjee. J. Electrochem. Soc., **107**, 80.
110. E. J. Seyb. Proc. A.E.S., **47**, 209.
111. D. M. Bigge. Plating, **47**, 1263.
112. W. H. Safranek. Metal Prog., **78**, 69 (July).

113. A. H. DuRose. Proc. A.E.S., **47**, 83.
114. H. Brown & D. R. Millage. Trans. Inst. Met. Fin., **37**, 21.
115. W. H Safranek, H. R. Miller, R. W. Hardy & C. L. Faust. Proc. A.E.S., **47**, 96.
116. C. H. Sample. Plating, **47**, 297.
117. M. Schwartz. Proc. A.E.S., **47**, 176.
118. G. Gutzeit. Plating, **47**, 63.
119. W. J. Crehan. Corrosion, **16**, 23 (Apr.).
120. W. G. Lee. Plating, **47**, 288.
121. K. T. Ziehlke, W. S. Dritt & C. H. Mahoney. Metal Prog., **77**, 84 (Feb.).
122. G. Gutzeit, P. Talmey & W. G. Lee. U.S. Pat. #2,935,425 (May 3).
123. E. A. Sullivan. U.S. Pat. #2,942,990 (June 28).
124. C. H. de Minjer & A. Brenner. U.S. Pat. #2,929,742 (Mar. 22).
125. R. A. Spaulding. U.S. Pat. #2,955,944 (Oct. 11).
126. P. Talmey & W. J. Crehan. U.S. Pat. #2,941,902 (June 21).
127. A. H. DuRose. U.S. Pat. #2,955,959 (Oct. 11).
128. A. M. Carlson & C. E. Prymula. U.S. Pat. #2,956,900 (Oct. 18).
129. W. H. Safranek, H. R. Miller & C. L. Faust. Plating, **47**, 513.
130. O. J. Jones, V. E. Carter & J. Edwards. Trans. Inst. Met. Fin., **37**, 40.
131. W. E. Lovell, E. H. Shotwell & J. Boyd. Proc. A.E.S., **47**, 215.
132. G. Dubpernell. Plating, **47**, 35.
133. S. Venkatachalam & T. L. Rama Char. Electropl., India, **2**, 22 (Apr.-July).
134. W. H. Safranek & R. W. Hardy. Plating, **47**, 1027.
135. A. A. Johnson & G. Dubpernell. U.S. Pat. #2,950,234 (Aug. 23).
136. J. E. Stareck, E. J. Seyb, Jr., A. A. Johnson & W. H. Rowan. U.S. Pat. #2,952,590 (Sept. 13).
137. J. A. Andrisek & T. R. Gill. U.S. Pat. #2,947,674 (Aug. 2).
138. F. Passal. U.S. Pat. #2,956,935 (Oct. 18).
139. M. S. Spivak. U.S. Govt. Res. Report PB 147 281.
140. R. J. Girard & E. F. Koetsch, Jr. Proc. A.E.S., **47**, 199.
141. I. L. Newell & A. Zavarella. U.S Pat. #2,929,769 (Mar. 22).
142. J. R. Dyson. U.S. Pat. #2,940,917 (June 14).
143. J. D. Greenwood. Electroplating, **13**, 322.
144. C. F. Corfe. Electroplating, **13**, 3, 48.
145. H. Suss. Corrosion, **16**, 105 (Oct.).
146. J. G. Poor, H. Chessin & C. L. Alderuccio. Plating, **47**, 811.
147. G. G. Storey & S. C. Barnes. Trans. Inst. Met. Fin., **37**, 11.
148. L. Serota. Metal Finishing, **58**, 73 (Jan.); 75 (Feb.).
149. L. Serota. Metal Finishing, **58**, 76 (Apr.).
150. L. R. Westbrook. U.S. Pat. #2,931,760 (Apr. 5).
151. C. N. Abbott. U.S. Patent #2,954,331 (Sept. 27).
152. E. Laue. U.S. Pat. #2,955,992 (Oct. 11).
153. W. Strauss & W. Willmund. U.S. Pat. #2,950,235 (Aug. 23).
154. G. C. Van Tilburg. U.S. Pat. #2,923,671 (Feb. 2).
155. M. C. Agens. U.S. Pat. #2,938,805 (May 31).
156. A. M. Carlson & C. E. Prymula. U.S. Pat. #2,956,901 (Oct. 18).
157. J. A. Gurklis, L. D. McGraw & C. L. Faust. Plating, **47**, 1146.
158. N. M. Geyer, G. W. Lawless & B. Cohen. Proc. A.E.S., **47**, 143.
159. W. Beck & E. J. Jankowsky. Proc. A.E.S., **47**, 152.
160. S. W. Strauss & P. N. Vlannes. Plating, **47**, 926, 1037.
161. S. W. Strauss & P. N. Vlannes. U.S. Pat. #2,938,840 (May 31).
162. L. Domnikov. Metal Finishing, **58**, 59 (June).
163. L. R. Kohan & H. T. Francis. Plating, **47**, 1155.
164. H. J. Bache & R. F. Robinson. Met. Fin. Journ. (Br.), **6**, 265.
165. C. J. Wernlund. U.S. Pat. #2,928,800 (Mar. 15).
166. C. J. Thwaites. Metallurgia, **61**, 113.
167. R. F. Higgs & J. A. McCarthy. Plating, **47**, 1255.
168. U. T. Hill. U.S. Pat. #2,931,759 (Apr. 5).
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170. H. H. Francisco, H. G. Ressler & G. W. Ward. U.S. Pat. #2,930,740 (Mar. 29).
171. A. R. Balden. U.S. Pat. #2,947,639 (Aug. 2).
172. M. A. Streicher. U.S. Pat. #2,940,867 (June 14).
173. I. Sanghi. Electropl., India, **2**, 11 (Apr.-July).
174. J. Cole & H. O'Neill. J. Inst. Metals (Br.), **88**, 159.
175. J. W. Price. Prod. Fin. (Br.), **13**, 65 (Mar.).
176. F. A. Lowenheim. Metal Prog., **77**, 126 (June).
177. U.S. Govt. Report PB 146 617.
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179. R. L. Rau & J. C. Bailar, Jr. J. Electrochem. Soc., **107**, 745.
180. R. Taylor & R. R. Phillips. U.S. Pat. #2,926,124 (Feb. 23).
181. D. E. Couch & J. H. Conner. J. Electrochem. Soc., **107**, 272.
182. V. Zentner. Proc. A.E.S., **47**, 166.
183. I. Tsu. Plating, **47**, 632.
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189. N. Hopkin & L. F. Wilson. Platinum Metals Rev., **4**, 56.
190. B. D. Ostrow & F. I. Nobel. Proc. A.E.S., **47**, 68.
191. W. B. Harding. Plating, **47**, 1141.
192. R. A. Ehrhardt. Proc. A.E.S., **47**, 78.
193. R. Seegmiller & J. K. Gore. Proc. A.E.S., **47**, 74.
194. A. F. Mohrnheim. Plating, **47**, 819.
195. F. W. Wild. Electroplating, **13**, 331, 373.
196. R. C. Barrett. Proc. A.E.S., **47**, 170.
197. A. N. Kappanna & E. R. Talaty. Electropl., India, **2**, 16 (Apr.-July).
198. V. Sree & T. L. Rama Char. Bull. India Section, Electro-Chem. Soc., **9**, 59.
199. W. C. Schickner. U.S. Pat. #2,934,478 (Apr. 26).
200. C. J. Wernlund. U.S. Pat. #2,943,029 (June 28).
201. G. T. Seaborg & A. C. Wahl. U.S. Pat. #2,951,018 (Aug. 30).
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203. N. J. Pierce. U.S. Pat. #2,932,609 (Apr. 12).
204. V. J. Schaefer. U.S. Pat. #2,924,535 (Feb. 9).
205. E. Carrington. Electroplating, **13**, 80, 126.
206. R. P. Yeck. U.S. Pat. #2,944,954 (July 12).
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210. W. G. Lee. U.S. Pat. #2,940,018 (June 7).
211. J. B. Langton. U.S. Pat. #2,947,064 (Aug. 2).
212. L. A. Bain, Jr. & R. A. Geshner. U.S. Pat. #2,958,928 (Nov. 8).
213. P. E. Ritt, Jr. & J. R. Sayers, Jr. U.S. Pat. #2,959,525 (Nov. 8).
214. G. P. McGraw, Jr. U.S. Pat. #2,948,261 (Aug. 9).
215. P. J. Clough & H. M. Farrow. Mat. Des. Eng., **52**, 12 (Sept.).
216. B. J. Williams. Electroplating, **13**, 247.
217. G. A. Shepard. U.S. Pat. #2,959,494 (Nov. 8).
218. M. F. Toohig. U.S. Pat. #2,940,873 (June 14).
219. O. F. Kuhlman. U.S. Pat. #2,960,457 (Nov. 15).
220. T. L. Scatchard. U.S. Pat. #2,930,879 (Mar. 29).
221. J. Schwindt. U.S. Pat. #2,925,062 (Feb. 16).
222. C. F. Powell. Mat. Des. Eng., **51**, 98 (Jan.).
223. L. W. Owen. Trans. Inst. Metal Fin., **37**, 104.
224. S. T. Wlodek & J. Wulff. J. Electrochem. Soc., **107**, 565.
225. H. Dorner. U.S. Pat. #2,955,957 (Oct. 11).
226. G. A. Samuel & J. V. Bell. U.S. Pat. #2,921,877 (Jan. 19).
227. C. Berger. U.S. Pat. #2,921,868 (Jan. 19).
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230. W. M. Bolton. U.S. Pat. #2,957,779 (Oct. 25).
231. R. F. Ayres. Metal Prog., **78**, 101 (Sept.).
232. D. B. Freeman & A. M. Triggle. Trans. Inst. Metal Fin., **37**, 56.
233. L. F. Spencer. Metal Finishing, **58**, 58 (Jan.).
234. C. W. Ostrander. Mat. Des. Eng., **52**, 116 (Aug.).
235. G. H. Pimbley. U.S. Pat. #2,927,874 (Mar. 8).
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237. N. J. Newhard, Jr. & D. Y. Dollman. U.S. Pat. #2,936,254 (May 10).
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238. G. H. Pimbley. U.S. Pat. #2,948,643 (Aug. 9).
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246. R. F. Drysdale & S. A. Burton. U.S. Pat. #2,930,723 (Mar. 29).
247. H. R. Neilson. U.S. Pat. #2,943,797 (July 5).
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250. L. McDonald. U.S. Pat. Reissue #24,875 (Sept. 27).
251. L. Morris & F. Lombardo. U.S. Pat. #2,944,919 (July 12).
252. G. F. Otto. U.S. Pat. #2,953,487 (Sept. 20).
253. H. A. Jenkins, D. B. Freman & G. R. King. U.S. Pat. #2,955,061 (Oct. 4).
254. R. E. Shaw & N. M. Ness. U.S. Pat. #2,935,431 (May 3).
255. R. J. Lipinski. U.S. Pat. #2,945,778-9 (July 19).
256. J. L. Ennis. U.S. Pat. #2,947,599 (Aug. 2).
257. D. L. Andersen. U.S. Pat. #2,926,108 (Feb. 23).
258. R. A. Westland, Jr. & H. W. Rudel. U.S. Pat. #2,927,080 (Mar. 1).
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261. L. G. Saywell. U.S. Pat. #2,943,945 (July 5).
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266. J. E. Eberhard. U.S. Pat. #2,963,439 (Dec. 6).
267. R. St. J. Emery. Electroplating, **13**, 253.
268. G. J. McKinley & A. Q. Jones. Plating, **47**, 634.
268A. J. P. Branciaroli. Prod. Fin., **25**, 50 (Dec.).
269. E. P. Bertin, R. J. Longobucco & P. M. Fitzgerald. Scientific Instr., **5**, 1 (Apr.).
270. A. E. Knotowicz & G. Tatoian. Plating. **47**, 645.
271. F. Lindstrom & H. Diehl. Anal. Chem., **32**, 1123.
272. R. M. Hertzog. Wire & Wire Prod., **35**, 327.
273. L. Serota. Metal Finishing, **58**, 66 (Mar.).
274. J. R. Crain. Plating, **47**, 1032.
274A. G. Gabrielson. Met. Fin. J. (Br.), **6**, 430.
275. R. W. Steinmetz. Proc. A.E.S., **47**, 45.
276. J. B. Mohler. Metal Finishing, **58**, 66 (Jan.).
277. J. B. Mohler. Metal Finishing, **58**, 91 (July).
278. J. B. Mohler. Metal Finishing, **58**, 71 (Apr.).
279. S. A. Watson. Trans. Inst. Met. Fin., **37**, 28.
280. W. H. Safranek, H. R. Miller, R. W. Hardy & C. L. Faust. Plating, **47**, 405.
281. M. R. Caldwell & L. B. Sperry. Plating, **47**, 396.
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283. J. D. Thomas, D. W. Hardesty & C. F. Nixon. Proc. A.E.S., **47**, 90.
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290. R. Quarendon. Prod. Fin. (Br.), **13**, 85 (Jan.); 91 (Feb.).
291. W. L. Cotton. Plating, **47**, 169.
292. T. P. Hoar & G. C. Wood. Trans. Inst. Met. Fin., **37**, 7.
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294. P. B. Mathur. Plating, **47**, 1274.
295. V. A. Lamb & P. A. Krasley. Plating, **47**, 176.
296. R. H. Zimmerman. Iron Age, **186**, 84 (Oct. 13).
297. G. B. Cook, C. E. Mellish & J. A. Payne. Anal. Chem., **32**, 590.
298. R. Kriegler & B. W. Schumacher. Plating, **47**, 393.
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300. E. A. Hanysz, C. E. Quinn & E. F. Weller, Jr. U.S. Pat. #2,920,269 (Jan. 5).
301. L. A. Greenberg. I. E. Chem., **52**, 83A (Aug.).
302. K. G. Robinson. Metallurgia, **61**, 3 (Jan.).
303. C. M. Fair, J. Water Poll. Control Fed., **32**, 632.
304. E. F. Druschel, J. F. Zievers & W. Zabban. Metal Finishing, **58**, 58 (Mar.); 66 (Apr.).
305. B. T. Hulse, R. P. Selm & G. E. Summers. J. Water Poll. Control Fed., **32**, 975.
306. Anon. Iron Age, **186**, 182 (Nov. 10).
307. F. D. Cooper. U.S. Pat. #2,939,763 (June 7).
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312. M. Pollack. Metal Finishing, **58**, 45 (Dec.).
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318. J. Round. U.S. Pat. #2,923,675 (Feb. 2).
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321. W. H. Jackson. U.S. Pat. #2,924,564 (Feb. 9).
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333. P. R. Allison. U.S. Pat. #2,944,945 (July 12).
334. R. Pyles. U.S. Pat. #2,931,764 (Apr. 5).
335. E. J. Smith. U.S. Fat. #2,921,893 (Jan. 19).
336. H. A. Nali. U.S. Pat. #2,938,850 (May 31).
337. G. Villette. U.S. Pat. #2,953,512 (Sept. 20).
338. R. R. Cheffers. Electroplating, **13**, 418.
339. R. J. Darrah. Prod. Fin., **25**, 44 (Oct.).
339A. J. G. Bartholomew. Met. Fin. J. (Br.), **6**, 432.
340. H. Hartley. Prod. Fin. (Br.), **13**, 69 (Mar.).
341. F. P. Roy & R. L. Sallo. U.S. Pat. #2,946,734 (July 26).
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346. S. C. Lawrence, Jr. Proc. A.E.S., **47**, 135.
347. C. A. Snavely. Proc. A.E.S., **47**, 139.
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By Daniel A. Marino, *Asst. Technical Editor*

Introduction

THE SEEMINGLY unreasonable demands made on organic coatings and organic finishing processes for Space Age ventures during 1959 appeared to have almost doubled during 1960. The Echo I satellite, composed of a Mylar skin only 0.0005 inch thick, measuring 10-stories high and having an area of 30,000 square feet, required a seven millionths of an inch thickness of high vacuum metalized aluminum.[1] Future satellites may be required to have a chameleon's ability to change their colors for protection[2] — not for camouflage purposes but rather to control the heat absorption and radiation qualities of the satellite. R. X. Meyer at Space Technology Laboratories, Los Angeles, stated that the coating can either take the form of a paint-like substance or a plastic applied in several layers. Among the 35 substances which he had found that carry out this 'chemeleon' activity at the required temperature levels, he pointed out that one changes from red to yellow with increasing temperature. Battley,[3] in discussing the rapid pace of development and discovery of new organic coatings, mentioned that in the next five years, another breakthrough is sure to occur in materials which as yet are not even out of the test tube.

The prospering organic coating materials field according to the Bureau of Census[4] appeared to be on its way to a new total sales record again in 1960. Paint, varnish, and lacquer sales during the first seven months of 1960 totalled 1.2 billion dollars, which is an increase of ½ per cent over the old record set in 1959. Industrial sales were 449.3 million dollars (2.1% higher than 1959) with paint and varnish at 332.1 million dollars (increase of 1.8%) and lacquer sales of 117.2 million dollars (increase of 3%).

Among some of the more interesting government sponsored projects concerning paint storage made available during the year was that relating to exterior storage by Merritt.[5]

Recently Developed Coatings

Though numerous paint manufacturers reported interesting improvements in their materials and placed many new products on the markets, relatively little information appeared in the technical literature last year concerning newly developed organic coatings. There was a fair amount of activity in the porcelain enameling field,[6-12] and Judd[9] received a patent for a lead-free, alumina-free porcelain enamel having a firing temperature range of between 900°F. and 1,050°F. Such a material is suitable for applying a coating to aluminum.

Evans[13] received a patent for a multiple layer acrylate-epoxy coating while Bell[14] developed a new method and product which, when baked at 250-400°F., becomes insolubilized, coating the entire metal surface.

It was reported by Farrows[15] that water thinned paints are beginning to make significant inroads in the United Kingdom. He further stated that although 14% of the paints sold in the United Kingdom in 1959 are of the water based variety, industrial paints of this type are only now being developed. Putalik[16] in an American journal and Woodbridge[17] in a British one pointed out the importance being shown the latex paints for industrial finishes. Bress and Field[18] surveyed the various improvements made in latexes for finishing products while Johnson[19] described the numerous problems encountered in trying to obtain latexes having satisfactory gloss characteristics for industrial finishing.

In a materials evaluation program reported by Foster,[20] sprayed linings for chemical process equipment were given laboratory screening tests. Among other advantages, it was concluded that spray applied lining materials can be used in many processes with decided economic benefit over other materials of construction.

Seaver[21] received a patent for a strippable organic coating containing cellulose acetate butyrate, plasticizer, and 0.2 to 1.5% soybean lecithin. A patent was received by Andrade[22] which described an organic coating consisting essentially of tertiary butyl alcohol and chromic acid.

A patent was obtained by Toulmin[23] relating to a method of coating metal substrates with polyethylene. A blend of benzyl dextran and dextran palmitate is first introduced into the polyethylene which, after application, is baked.

Materials for Coatings

In a series of articles, Preuss[24] gave an up to date review of the more important resins being used in modern organic coatings. Indications are that the review will not only serve as a good refresher course for paint technicians but also will provide a simplified guide, even for the only casually interested, to the ever expanding family of synthetic resins. In discussing the manufacture and properties of urea resins, Preuss[25] compared them with the melamine types, mentioning that urea resins are somewhat less costly and are normally used in the more "heavy duty" applications. Preuss also reviewed the silicones,[26] mentioning

that silicone aluminum paints can be formulated to withstand temperatures in the range of 1,000°F.; when the paints finally fail, instead of oxidizing and crumbling, they slowly volatilize, leaving a metallic aluminum coating firmly fused to the steel.

Vinyls

In addition to the usual methods of preparing textured vinyl finishes, that is, by laminating them on sheet material or by spraying and applying a texturing agent on the uncured vinyl layer, another interesting method was reported being used.[27,28] This consists of spraying the vinyl plastisol or organosol on to a metal surface which itself has been textured. The resulting coating shows the textured grain of the metal substrate to which it was applied.

Day[29] reported that the use of vinyl resins for appliance finishes will increase because of recent developments. Today, vinyl polymers are used mainly in crosslinking types for appliance coatings. This development facilitates the use of higher solids content and cheaper solvents and produces better adhesion, solvent resistance, and hardness. Another improvement in the vinyls field which promises to enable vinyls to withstand temperatures of 200°F. was reported in the literature.[30]

Epoxies

Formulation and properties of amine cured epoxies was discussed by Glaser.[31] Development of pure peracetic acid on a commercial scale which was announced in 1960 may have a pronounced effect on an extremely large number of currently popular organic finishes.[32] Though batchwise condensation of epichlorohydrin and bisphenol-A will remain important, epoxidizing compounds produced (which are of greater range) by reacting hydrogen peroxide with acetic acid in the presence of formic acid, sulfuric acid or ion-exchange resins as catalysts, will face serious competition. The pure perchloric acid does not contain strong acid or salts that catalyze side reactions. Initial quantities of these new epoxide compounds being placed on the market include resin forming materials and plasticizers. Since they incorporate catalysts or hardeners, they are ready to use, one-component systems.

Urethanes

At the Paint Industries Show[33] in Chicago a new quick drying, "tack free in ten minutes," urethane coating vehicle was unveiled. This should add still further interest in the rapidly growing (8 million dollars in 1960 compared to 3.2 million dollars in 1959) urethane coatings field. A major reason for the boom in urethane finishes is the growing popularity of the oil-modified type which does not have the limited pot life as have the heavy duty two component systems. Although the one-package urethanes are more convenient to use and are less expensive, to date they are not nearly as durable as the two-package reactive types.

Patents were granted for a number of organic coating materials.[34-37] Schulze[38] received a patent for organic protective coatings for galvanized surfaces consisting of applying non-leafing type aluminum granules primers over roughened zinc followed by applying top coat finishes and curing. An extensive review[39] of the properties and use of aluminum paste pigment in organic finishes was presented at the 1960 Annual Conference of the British Institute of Metal Finishing. It was pointed out that a leafing aluminum top coat performs well over a non-leafing aluminum priming paint containing zinc oxide or basic lead sulfate for structural steel items. Koenecke[40] recommended using either epoxy or butoxy coatings to protect structural materials which are to be under cathodic protection.

With the accumulation of so much material on the properties of various surfactants, Beck[41] noted that some could now be selected for specific jobs by first reviewing their published characteristics. He further stated, however, that in the final analysis, the compounder himself usually must rely on results of his tests in order to choose the best type. It was also pointed out[42] that certain color pigments can be adversely affected by improper grinding. By fracturing the basic particle of the pigment, the color is changed. Particular care should be exercised with the very red molybdate orange pigment which has large friable particles. Beck[43] also indicated that the tendency among formulators is in the direction of shortening mill times. He feels that often, stopping at the indicated dispersion (by measurement of particle size) is a mistake, and the grind should be continued further to obtain the best results.

Testing and Inspection Procedures

A number of valuable reference works dealing with inspection techniques, some of which were government sponsored, were made available last year. One report[44] which was compiled by the Naval Civil Engineering Laboratory at Port Hueneme, Calif., presented a catalog of infrared spectra of paint vehicles conforming to selected specifications and of drying oils used in paint formulations. It is intended to be used as a reference for inspection and identification of non-volatile vehicles of paints. Hitchcock[45] investigated the feasibility of applying mass spectrometry to paint vehicle analysis. He found that a Pyrex glass heated-inlet system can be used to introduce the vapors of paint vehicles into a mass spectrometer and that in spite of random variations in molecular structure induced by elevated temperatures, a distinct cracking problem can be associated with each vehicle. Swann[46] described a method of detection of oiticica oil, while Ohr conducted studies of organic coatings exposed to gamma radiation. The radiation stability of various coatings tested (some of which showed significant degradation changes in color and film properties after exposure of only 8×10^7 roentgens) was explained in terms of polyester structure and chemical groupings.[47]

Roberts[48] described the many improvements made in the National Bureau of Standards *Abrasive Jet Method* for measuring abrasion resistance of coatings since its first introduction into the field. He showed how this rapid, reproducible, and versatile means for measuring the abrasion resistance of organic coatings can also be used to measure such other materials as porcelain and anodic coatings.

New techniques were described[49] which show the presence or absence of discrete enamel layers, their number and thickness, and the degree of symmetry of the enamel build on magnet wire insulation. These new techniques were developed in order to properly evaluate coatings in an effort to find some which could satisfactorily withstand the higher temperatures they are being subjected to in motors. The types of coatings investigated included polyvinyl formal, polyester, and acrylonitrile-acrylate copolymer. A series of interesting photomicrographs of coated wire were presented.

Beck[50] stated that recent work in the field of paint formulating has shown that fineness of grind is not the only important factor of dispersion. Although with many formulations, all that is necessary is to achieve the requisite fineness of grind to obtain a good product, others require further grinding beyond that necessary for the desired fineness of grind rating.

Bley[51] working on a continuing study of surface preparation, reviewed a number of methods. He placed particular emphasis on sandblasting as a pretreatment.

Recently Developed Application Methods

Both the technical trade and patent literature of 1960 were replete with information concerning new methods of applying organic finishes. A large number of patents were issued for various vacuum metalizing[52-59] processes. Self[60] believes that since it is now possible through the use of good application control to minimize rejects in vacuum metalizing, the field is passing a major milestone where much more rapid expansion in the use of the process will be seen in coming years, particularly in the higher quality applications.

Numerous patents were also issued for other methods of applying finishes with spray guns,[61-71] airless spraying,[72] and especially by electrostatic spraying.[73-90] One[90] such patent was issued for applying multicolor coatings electrostatically. Johnson[91] described an interesting method of spray painting. Paramagnetic pigments are used to guide paint particles toward parts which are in a magnetic field.

Descriptions of organic finishing installations were also numerous in the 1960 technical trade literature. Marotta[92] made a comparative study of convection ovens and infrared ovens for curing thermosetting enamels. It was shown that the latter are often superior with regard to convenience and high quality finish. A number of informative graphs showing warm-up times for each system of heating were included in the discussion.

Two flow coating lines were described[93] which are being used to coat automobile and truck body parts. Both machines are forty feet in length, however, the automobile vapor tunnel (drip area) is 560 feet while the truck vapor tunnel is only 300 feet long. Young[94] described a spray painting installation which was planned after considering the relative merits of batch and conveyor types of processing. It was reported by Sekules[95] that the largest paint dip tank in the Southern Hemisphere is being used in an automatic paint shop. His description of the various equipment in the shop indicates it is a modern, well planned installation. Rudolph[96] described a custom painting shop which handles a large range of parts. The plant and equipment are designed to make possible the maximum of versatility, yet have some automatic operations. Wet hand sanding of organic enameled items helps account for some excellent finishes on some European motor scooters.[97]

A closer look was taken by Schumacher[98] at the relatively new trichlorethylene thinned paints and their method of application. He described a recent development in the field called the *spray-in-vapor* method which further increases the range of items which can be economically coated with trichloethylene thinned paints. An elaborate study was made to compare various finishing cycles from a cost standpoint listing: 1) detergent cost, 2) paint and thinner costs, 3) utilities costs, 4) tax, depreciation, and investment carrying costs, and 5) labor and maintenance costs. The study pointed out that in some areas techniques utilizing trichlorethylene thinned paints offer substantial savings in operating costs. A serious investigation of this fresh approach to organic finishing should be made by all those faced with seemingly excessive paint finishing costs.

It was mentioned[99] that lead oxide and lithium phosphate porcelain enamel finishes can now be applied to magnesium in those cases where the metal is given a new surface pretreatment which promotes adhesion. Kautz received a patent for a vitreous enamel composition for coating aluminum. Thake[100] in describing methods for coating aluminum, emphasized the importance of first obtaining a clean surface.

Since automobile buyers are so highly interested in the color variety of their purchase, auto manufacturers have been making a concerted effort to provide sufficient facilities to enable them to apply these colors. In an article describing a Ford Motor Co. installation in California, Fifield[101] reports that along with being able to apply coating material, primer, and surfacing, paint outlets for forty different colors are also available in the spraying area.

Prefabricated galvanized metal buildings are now receiving a pigmented vinyl coating prior to assembly.[102,103] The panels, after forming, are automatically primed then sprayed with vinyl and oven cured. A new field is opening for the die caster. A group of frits and pigments are now available[104] which can be fired at 1000°F. If die castings are made by vacuum die casting so that they do not blister when heated and an alloy is used which will not sag at firing temperatures, the aluminum die casting can be porcelain enameled.

Spraying of Reinforced Plastics

The burgeoning field of applying reinforced plastics resins with spray guns is rapidly finding applications.[105,106] In one system,[105] often called "spray up," a complete reinforced plastics product can be produced by spraying the material on a removable form. Loose glass fiber combines with the polyester resin as it is emitted from the spray gun to form a thick, rigid, removable surface coating. Though thickness is a major problem (success of the operation depending heavily upon operator skill) numerous advantages of spray up have become evident. Some of these are: 1. one may use tapered wall sections and built-up radii that dis-

tribute stresses more efficiently; 2. different glass/resin ratios within the same part may be used when required in high stress areas; 3. metal components may be partially assembled and coated to prevent corrosion attack. In another system,[106] the coating produces a hard, thick barrier consisting of multiple layers of glass (for strength) interleaved in a polyester resin (for chemical resistance). This system is particularly good for applying heavy corrosion protective liners on ductwork, some plating tanks, and machinery exposed to corrosive fumes. Thicknesses of 20 to 30 mils are easily obtained with this resin plus glass flakes mixture. This second system differs from the first mentioned by not requiring cumbersome glass chopping equipment in conjunction with spraying.

A patent was granted to Trittipoe[107] for a spray booth design which incorporated a liquid containing settling tank at the bottom.

Specialized Coatings

Along with the specialized coatings developed for space probes (previously mentioned above), a number of other interesting finishes were reported in the technical literature of 1960. Lockhart[108] at the Naval Research Laboratories issued a final report on reflection reducing coatings while Knanishu[109] at Rock Island Arsenal Laboratories discussed heat and light reflective coatings. Rice[110] reported on heat resistant paints for rocket launchers.

The Department of Defense which has realized at the outset of nuclear warfare that a very serious danger of atomic explosions is fire as the bomb circle expands, has looked into the possibility of minimizing bomb damage by using fire retardant paints. Miller[111] of the Corps of Engineers and coworkers have developed satisfactory specifications for both exterior and interior types which meet all military specifications. A basic formulation specified by Miller's group follows:

	Ingredient	*Pounds/100 gallons*
1.	Mineral Spirits	105
2.	60% Silicone Solution	3
3.	Aluminum Stearate	2
4.	Mono-ammonium Phosphate	100
5.	60% Alkyd Vehicle	346
6.	70% Chlorinated Paraffin	55
7.	Starch	142
8.	Turkey Red Oil	3
9.	Zinc Borate	210
10.	Titanium Dioxide	2200
11.	8% Lead Naphthenate	22
12.	ASA	0.5

Miller incorporates the three common characteristics of a good fire retardant paint, that is, the mechanism for reflectance, dissipation, and absorption. *Reflection*—special infrared reflecting pigments; *Dissipation*—certain conductive metal pigments which scatter or dissipate the incident energy entering the film; *Absorption*—intumescent material which absorbs enough incident energy to decompose and liberate inert gases (such as nitrogen, carbon dioxide and water vapor) causing the film to foam and form an insulating layer on the surface to which it is applied.

Development work is being done on ice-phobic paints for shipboard use. These are paints to which ice shows little or no adhesion to. A report by Lacks and Quatinetz[112] describes the ice shear adhesion application and test method employed in a project to measure the adhesion of ice to a surface, and reviews the variables involved in such measurements. The report also lists other items of equipment used in the work.

Miscellaneous

Delmonte[113] described an inexpensive method for preparing re-usable paint spray masks with epoxy resin. He pointed out that along with the cost savings of an epoxy mask over that of an electroformed mask, the former type will also allow the user to obtain a certain amount of springback for close fit. This characteristic (he stated) is difficult to obtain with an electroformed mask.

Both Hannah[114] and Leithauser[115] received patents for paint strippers. Hannah's material, which contains polyhydric alcohol, is used hot and is reported to be effective for removing oleoresinous ester gum and alkyd resin based paints. Leithauser's calls for immersing items having synthetic protective coatings in a phenol (or cresol) base containing orthophosphoric acid and wetting agent.

Continuing stress was put on methods for improving both good maintenance painting programs[116] and fire fighting programs.[117] For fire fighting, it was mentioned that water has always been the basic chemical and even though it cannot be used for fires where the burning chemical will react with it, it will absorb more heat and usually at a faster rate than any other fire fighting material. Heat absorption can further be improved by spraying or reducing its surface tension. An interesting new theory in fire fighting has passed into the practical stage with the installation of the world's first air foam sprinkler fire fighting system.[118] The system is called 'equivalent isolation' which means, in effect, the ability through special fire protection methods, to establish isolation of equipment and processes from spilled flammable liquid fire hazards which cannot physically be removed before they are damaged. A ten point typical operation sequence was described.

Feuer[119] found that, while wide differences exist in the corrosion resistance properties of polyester resins, one significant characteristic polyesters show is the inapplicability of finding a fast screening technique as an index of corrosion resistance. In the tests, certain resins were immersed in eight corrosive aqueous solutions (e.g., sodium hydroxide, sulfuric acid, hydrochloric acid) for periods ranging from 24 hours to 90 days and changes in physical properties were noted. It was found that a resin might withstand the screening test but not hold up after longer immersion periods.

An aircraft manufacturer reports[120] savings of upward of $50,000 by masking items with organic strippable coatings. In order to prevent damaging parts upon removal, the company requires breaking the film with a sharpened piece of Micarta then manually peeling the coating away from the break.

A patent[121] was granted for a water wash spray booth compound containing a water-soluble cellulose ether. In describing a procedure for setting up a paint stripping installation, Pfeffer[122] outlined some strip-

ping problems and their respective solutions involved in the development of method and equipment for using a new stripping solution.

Finally, Sharpe,[123] in promoting greater usage of pre-finished sheet metal, took issue with the paint shop, calling it the "Cinderella of departments, with high overheads and paint costs and perhaps even a relatively poor finish . . . . . at the end!" (*Editor's Note—Exclamation point supplied*)

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Nickel-Chromium Plated Aluminum Sheet

Atmospheric Corrosion Resistance

By R. C. Spooner and D. P. Seraphim, *Aluminium Laboratories Ltd., Kingston, Ontario, Canada*

This is the second and concluding part of the article by Messrs. Spooner and Seraphim. Part I appeared in the December 1960 issue.—*Ed.*

(b) *Industrial Atmosphere*:

The heavy film of oily dirt and soot on the two sets of panels exposed in Montreal for 20 and 26 months was removed with difficulty by brushing with a hot water detergent solution. This revealed extensive staining on all panels, which was removed by a mild abrasive cleaning treatment or brief immersion in dilute nitric acid to detect underlying pitting and blistering attack.. The appearance ratings listed in Table 4 are based only on these two types of surface defect and do not include the staining effect.

The ratings and visual appearance (Fig. 6) of the panels indicate the small but significant decrease in weathering attack with greater nickel coating thickness. The panels exposed for 26 months suffered slightly more deterioration than those exposed for 20 months. There was no significant difference between the panels nickel/chromium plated here and those processed under commercial conditions. In the case of the grooved panels, attack adjacent to the grooves decreased with higher nickel thickness accompanied by a lesser amount of dust and soot accumulation. In several instances, the grooved panels suffered less attack than the accompanying nongrooved panel. A few small pits or blisters were noted along the grooves in some panels with a 0.5 mil thickness of nickel.

Three normal types of attack were noted on the front surfaces, namely pitting, blistering, and staining. The pitting was very fine, uniform and detracted from the surface appearance only slightly. Blistering was due to penetration of the coating and corrosion of the aluminum. The growth of corrosion products caused a small blister to form at the surface around which the soot adhered tenaciously. Blisters occurred on fifteen out of twenty-four panels, including eight panels with a 0.5 mil, five with 1.0 mil, and two with

Fig. 6. Phosphoric acid anodized Cu/Ni/Cr plated 3S panels after 26 months exposure in industrial atmosphere: front surface after removal of staining. (Nominal nickel thickness [mils] left 0.5, center 1.0, right 1.5, bottom two rows, Ni/Cr plated commercially. 0.5X).

TABLE 4

Appearance Ratings on Cu/Ni/Cr Plated Phosphoric Acid Anodized 3S Panels Exposed in an Industrial Atmosphere

Nominal Nickel Thickness (mils)	*Appearance Ratings Front Surfaces Exposure periods (Months)* 6	20	12	26
0.5	10	7.0	10	6.2
0.5*	10	7.8	7.6	6.1
0.5 (A)	10	7.4	10	6.1
0.5 (A)*	10	7.4	10	6.2
Average	10	7.4	9.4	6.2
1.0	10	7.5	6.9	6.0
1.0*	10	7.2	10	7.5
1.0 (A)	10	6.7	9	5.5
1.0 (A)*	10	7.2	10	7.5
Average	10	7.2	9	6.6
1.5	10	7.5	10	7.3
1.5*	10	7.5	9.3	7.5
1.5 (A)	10	7.5	10	7.2
1.5 (A)*	10	7.5	10	7.5
Average	10	7.5	9.8	7.4

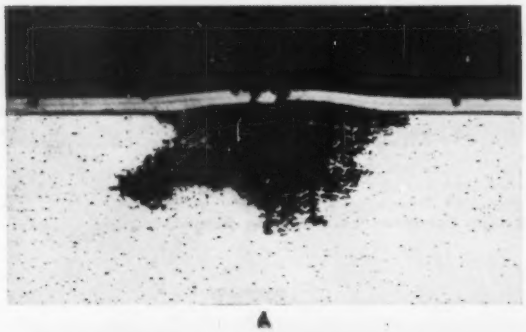
*Grooved panel.
(A)—Ni/Cr plated by commercial laboratory.

the 1.5 mil nickel coating thickness. The blisters were small and, in most cases, few in number. Flaking was absent. Staining varied from light to moderate in degree, but covered from 50 to 90% of the surface and was a light grey or brown color. The latter color was confirmed as due to attack of the copper under-deposit. Staining was only slightly less with the heavier nickel deposit.

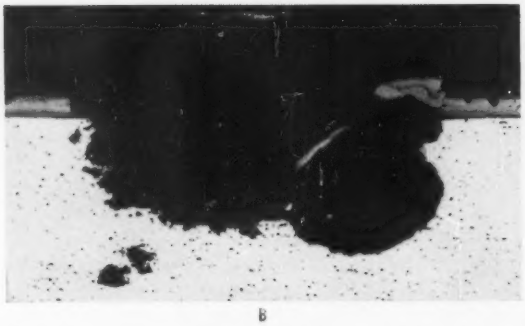
The small amount of attack adjacent to the grooved lines exposing bare aluminum indicated the good adhesion and corrosion resistance of the coating.

The back surfaces of the panels showed effects similar to those on the front but to a greater degree. Heavy staining accentuated by residual soot was a prominent feature. Blisters were much more frequent but remained small in diameter. No flaking was noted.

Examination of coating cross-sections of three panels with different nickel thicknesses exposed for 26 months in Montreal showed general surface pitting attack on both surfaces of all panels and with greater severity on the back surfaces. Increased nickel thickness greatly decreased this attack. With the 0.5 mil coating, pitting on the front surface had penetrated to, but had not attacked, the aluminum. On the back surface appreciable amounts of corrosion products were noted at the aluminum/aluminum oxide/copper interface. This is illustrated by Fig. 7a showing an area on the back surface where the deposited coating, although broken, was still essentially intact and adherent, and by Fig. 7b, where the plated deposit on the same surface has cracked and been forced away. The increased severity of attack on the back as compared to the front surface was very marked. On the panel with a 1.5 mil nickel coating, pitting penetration through the nickel had not taken place on the front surface (Fig. 8). This had occurred on the back surface but no blistering was noted.



A



B

Fig. 7. Two stages in corrosion attack on back surface of phosphoric acid anodized Cu/Ni (0.5 mil)/Cr plated 3S panel after industrial atmosphere exposure for 26 months. (90X).

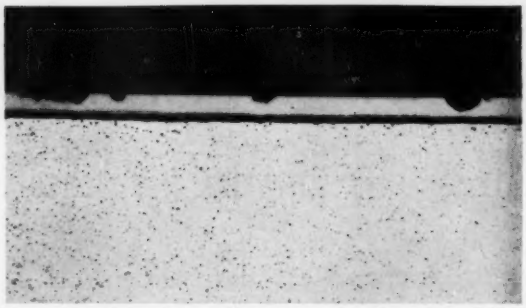


Fig. 8. Corrosion attack on front surface phosphoric acid anodized Cu/Ni (1.5 mil)/Cr plated panel after industrial atmosphere exposure for 26 months. (90X).

Discussion

(1) Comparison of Plating Processes:

The behavior of panels plated by the three processes has been summarized in Table 6* for salt spray,** semi-rural and severe industrial atmospheric exposures. The salt spray results were secured during preliminary laboratory evaluation of panels plated by the three processes and their modifications, prior to the investigation of their atmospheric corrosion resistance, reported above.

Practically all the panels "passed" or showed only minor attack during salt spray exposure for 500 hours, a much longer period than that specified for nickel/chromium coatings in earlier (before 1955) A.S.T.M. or in automotive specifications which seldom exceeded a period of 96 hrs. Current A.S.T.M. specifications for nickel/chromium plated coatings*** do not list salt spray exposure requirements because of failure to obtain consistent results under commercial testing conditions in various laboratories. The recent development of laboratory tests with much better correlation to service behavior, e.g. acetic acid salt spray, "Corrodkote" and others, should lead to realistic specifications.

Semi-rural atmospheric exposure for 24 months provided a more severe test than salt spray exposure for 500 hours. The phosphoric acid anodized panels showed little or no attack even with nickel thickness at 0.5 mil (minimum thicknesses were as low as 0.4 mil). The Vogt-processed panels suffered slight attack with some blistering. The behavior of the zincated panels depended on the nickel thickness, but those with a nominal 1.0 mil (minimum 0.8 mil) or more of nickel thickness were in good condition, with no blistering attack. Failure by blistering occurred in the cases of zincated panels with the very thin nickel coating of 0.4 mil minimum thickness and with a few

*Both the nominal thickness and the minimum actual thickness determined on selected samples are shown in Table 6. The good agreement noted for the Vogt series panels was due to the use of a plating shield: otherwise, minimum values were appreciably lower because of edge thickness buildup.

**ASTM B 117-57T, 3.5% salt solution, 90°F.

***On steel (A 166-58T), copper base alloys (B 141-58) and zinc base alloys (B 142-58).

TABLE 6

Comparison of Corrosion Resistance of Ni/Cr Plated 3S Panels Prepared by Zincate, Phosphoric Acid Anodizing, and Vogt Processes

Preplating Process	Coating Thickness (mils) Nominal (Actual Minimum) Cu	Ni	Cr	Salt Spray (500 hours)	Behavior During Exposure Semi-Rural Atmosphere	Industrial Atmosphere
Zincate	(0.3)	0.5 (0.4)	0.01 (0.007)	slight blistering and pitting attack.	failure by blistering between 12-24 months.	complete failure by blistering and flaking in 6 months.
	(0.3)	1.0 (0.8)	0.01 (0.007)	little or no attack.	slight deterioration by pitting in 24 months.	"
	(0.3)	1.5 (1.4)	0.01 (0.007)	little or no attack.	good condition after 24 months.	"
Vogt		1.0 (0.9)	0.01 (0.015)	little or no attack: heat-treated panels with immersion zinc had severe blistering.	fair to good condition after 12 months with occasional slight blistering.	failure by blistering and flaking within 8-12 months.
Zincate	(0.3)	1.0 (1.05)	0.01 (0.015)	little or no attack: heat-treatment without effect.	fair - good condition after 12 months.	failure by blistering and flaking within 8-12 months.
Phosphoric Acid Anodizing	(0.4)	0.5 (0.4)	(0.01)	slight staining at several points on all panels.	after 24 months excellent condition with no blistering.	after 26 months only light blistering, but severe staining and extensive fine pitting attack.
	(0.4)	1.0 (0.7)	(0.01)	slight staining at 1-5 points on some panels.	"	as above but less blistering.
	(0.4)	1.5 (1.0)	(0.01)	free of staining and pitting attack.	"	as above but virtually no blistering and decreased staining.

Vogt panels. Other panels in these two sets were in good condition, marred only slightly by fine pitting attack.

The results of exposure to industrial atmosphere showed a sharp differentiation between the three plating processes. All panels for the zincate and Vogt procedures failed within a year by severe blistering and flaking attack. In certain cases this was not unexpected, because of the thin nickel coating and the severity of the exposure conditions. The nickel thicknesses recommended for this type of exposure on steel are generally 1.5 mils, and most of the zincate and all the Vogt panels had a minimum value of less than 1.0 mil. The phosphoric acid anodized plated panels had a much higher degree of corrosion resistance. Pitting, blistering, and staining occurred but the effects were restricted and did not cause marked failure of any panel. This is particularly impressive because the minimum nickel coating thickness ranged between 0.4 and 1.0 mil. The higher resistance of these panels appears due to the greater difficulty for corrosion to proceed in a lateral direction from individual pits, either at the copper-nickel, aluminum oxide-copper or aluminum-aluminum oxide interfaces. Thus, surface attack leads to pitting, which causes staining as it penetrates the coating but remains relatively small in cross section and does not develop corrosion products sufficient to blister the coating. The superior keying action of the copper in and to the oxide film is probably another contributing factor in preventing blistering.

The above summary for the three plating processes investigated indicates that bright "chrome" plate on 3S suitable for prolonged exposure outdoors can be best prepared by using the phosphoric acid anodizing treatment followed by plating copper and an adequate thickness of nickel (1.5 mils). The use of the zincate or Vogt processes yields deposits which are more prone to blister, particularly when thin nickel coatings are employed and, hence, should be restricted to mild service applications. Thicker nickel deposits are required for more severe service conditions.

(2) Service Performance of Plated Aluminum Using Zincate Process:

The poor corrosion resistance of the plated panels prepared by the zincate process on exposure outdoors, particularly in industrial atmospheres, was disappointing but not unexpected. Although only slight reference is made to atmospheric exposure results in three major studies[10,13,14] of this technique, it is stated[10] that,

even for moderately severe corrosive conditions, the nickel thickness should be from 1.5 to 2.0 mils in thickness. Atmospheric conditions in Montreal are severe and all the panels had minimum nickel thicknesses below those suggested.

A factor promoting blistering and flaking on plated panels exposed to severe atmospheric conditions is the manner of growth of the immersion zinc layer[15, 16] and its non-continuous structure, particularly with thin deposits (Fig. 9). The coating density varies considerably, as shown by areas of light, moderate, and heavy deposit, and these probably are related to grains of differing orientation. Typical areas are shown in greater detail in Fig. 10. The growth of the zinc film during immersion periods longer than the 10 second period (Figs. 9 and 10) will increase the overall surface coverage by more and probably larger individual deposits of zinc. If Edwards and Swanson's[4] suggested pattern is correct the zinc deposit will be in direct contact to the aluminum only at discrete nucleation points or areas, and with no direct adhesion at the non-nucleated areas. Zelley[14] has commented that extremely thin zinc deposits are not continuous films of pure zinc, but that this is not detrimental provided there is sufficient zinc to provide satisfactory electrodeposition and, in fact, this can be beneficial from a corrosion point of view. However, the adhesion of a copper deposit either to a non-continuous zinc film or to one that is adherent to the substrate only at points would be expected to be less than to a continuous deposit, such as that of a thicker plated zinc deposit.

In considering the results obtained with zincate-processed panels, the severity of the industrial exposure conditions must be remembered; it appears reasonable that one year without cleaning is equivalent to several years of service with occasional washing and waxing.

The first series with the zincate process employed "bright" copper and nickel proprietary baths, while the three zincate sets (F, G, H) included with the Vogt series, used Rochelle copper and Watts nickel solutions, followed by buffing the dull nickel deposit before chromium plating. It is often stated that the corrosion resistance of the buffed Watts nickel is higher than that of bright nickel. The results obtained did not show this effect, possibly due to the severity of test conditions and the limited number of panels exposed.

The problem with the zincate process is the protection of the Al/Zn interface from corrosion attack following pitting penetration of the Ni/Cr layers, which, under extreme conditions, may lead to blistering and flaking. Decreased thickness and increased uniformity of the zinc film is beneficial but the deposition of a more protective Ni/Cr deposit is essential. Zelley[14] has suggested the use of a modified zincate solution along with the double immersion procedure to secure a better plated coating. Even so, a nickel coating thickness of 1.5 mils or preferably 2.0 mils is required to provide satisfactory outdoor resistance under severe exposure conditions; this is particularly true in the case of die castings.[17]

(3) Phosphoric Acid Anodizing Process:

The excellent resistance of phosphoric acid anodized plated 3S panels to blistering attack suggests the value of this process for plating other aluminum alloys. Phosphoric acid anodizing produces an oxide film with pores of relatively large diameter ($\sim$ 330Å),[18] considerably greater than that of the pores in, say, sulphuric acid films ($\sim$ 120Å) and this is helpful to the formation and keying in of the initial copper deposit. Plating a nickel coating directly on the anodic films[19] would eliminate the objectionable staining noted above due to attack of the copper film under the nickel with, it is believed, no loss of corrosion resistance.

Anodizing as a preplating procedure requires a higher voltage power source than that required for plating, and a slightly different technique. These requirements are met readily. Anodizing may also appear less convenient than zincate solution treatment because of the longer time required but, in practice, the difference may not be great. The use of a double zincate treatment requires seven procedures (two zincate immersions, a nitric acid strip, two single, and a final double water rinse) as compared to three

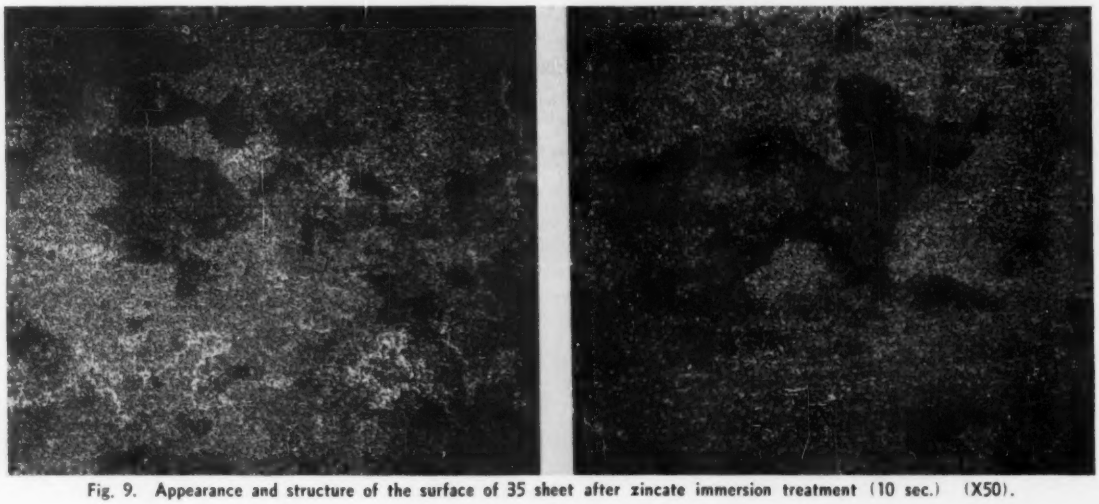
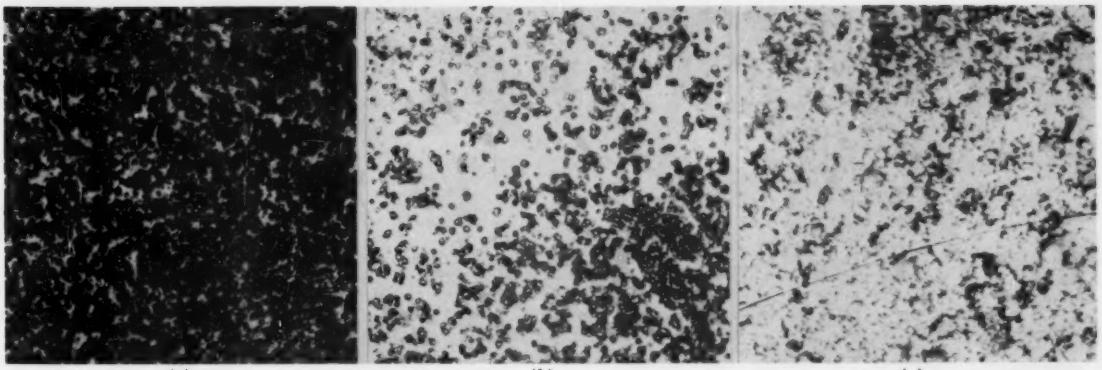


Fig. 9. Appearance and structure of the surface of 35 sheet after zincate immersion treatment (10 sec.) (X50).



(a) Very Dark Area (b) Greyish Area (c) White Area

Fig. 10. Variations in coating density on 3S sheet after zincate immersion treatment (10 sec.). (Taken with incident illumination, X1000).

steps (anodizing and double rinsing) with an anodizing procedure.

The combination of the phosphoric acid anodizing preplating technique with deposits in adequate thickness of recently developed types of nickel and chromium, with their superior corrosion resistance, should show superior performance under outdoor exposure conditions.

(4) Atmospheric Exposure of Bright Nickel/Chromium Coatings:

For many years there has been much discussion about the porosity of electrodeposited nickel coatings and its effect on the behavior of bright nickel-chromium deposits during outdoor exposure. Recently, emphasis has been placed on the pitting attack that is produced by weathering, particularly under severe industrial conditions,[20-23] due in part to the operation of the nickel/chromium galvanic cell. The thickness and type of chromium deposit is a major factor, while the nickel thickness is of critical importance. It is probable that the pitting rate decreases with pit depth and, thus, the benefit of increased nickel thickness is greater than would be expected by a direct linear relationship. Electrodeposited coatings with increased corrosion resistance have been produced by use of composite coatings such as a double layer of nickel, or a Ni/Cr/Ni or Cr/Ni/Cr type coating instead of one of uniform structure, or by heavier chromium coatings.

There has been a slow but continued increase in the nickel coating thickness specified for severe outdoor conditions. Sample[21] has described the rise in required thickness in one type of application from 1.25 mils in 1940 to 2.0 mils in 1945, while still thicker deposits are required when higher quality and improved durability are specified.

It is clear that bright "chrome" over nickel whether on steel, aluminum or on other basis metals is subject to severe weathering and pitting attack during industrial atmospheric exposure. Significantly heavy nickel thickness is required to yield satisfactory corrosion resistance under such conditions. The changes in plating procedure mentioned above should also increase this resistance and reduce the required nickel thickness. These plating improvements have been demonstrated generally on steel or zinc, but improved corrosion resistance should also be obtained with similarly plated coatings on aluminum and its alloys. The high corrosion resistance obtained by the improved techniques, along with the excellent weathering resistance of aluminum alloys and their freedom from colored corrosion products, should increase the use and widen the range for service applications of plated aluminum alloys.

Acknowledgement

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Developments in Fluid-Bed Coatings

By Peter W. Sherwood

FOLLOWING several years of engineering development, the fluid-bed method of coating is now coming up fast in the field of surface finishing. Particular importance attaches to the process in finishing small objects. Introduced to the United States in the mid-1950's, a survey in early 1959 showed 26 firms operating the process and one large mechanized custom coating plant built exclusively for fluid-bed coating. Considerable construction activity continues to expand this active field.

The process, discovered in Germany during 1952, competes with dipping, brushing, spraying, and extrusion methods as well as with the newer techniques of flow coating, electrostatic spraying, and electrophoresis for applying coatings. Among the chief advantages claimed for fluid-bed coating, are absence of solvents, ability to coat complex shapes, single-pass operation, suitability for applying coatings of widely varying thickness, materials utilization approaching one hundred per cent, inexpensive process equipment amenable to complete automation, and formation of smooth continuous coatings.

The Method

In outline, fluidized-bed coating is a very simple technique (although considerable engineering problems are encountered in practice). Briefly, a fine plastic powder (50-150 mesh) is blown with nitrogen or air to form a uniform soilds-in-gas suspension (a "fluid-bed") inside the coating vessel.

The object to be coated is submerged into this fluid bed under conditions which will cause the plastic powder to adhere to its surface. Most commonly, this is accomplished by preheating the parts to be coated to a temperature somewhat above the fusion point of the plastic (while the temperature of the fluid-bed itself must be controlled to keep the plastic in the solid state). To overcome the difficult temperature control problem in this approach, two alternative techniques have recently been developed to cause the plastic to adhere to the immersed object's surface. First is the use of electrostatically charged plastics particles, and, secondly, use of a thin tack undercoating applied to the object in a preliminary operation. Such undercoatings may either have the same composition as the final coat or they may be plasticizers; they are applied by spray, paint, or dip methods.

Regardless of the method elected for causing adhesion of the plastic powder to the immersed object, thickness of the coating can be controlled, within limits, by adjusting the time of exposure to the fluid-bed phase. In many instances, furthermore, it is necessary to follow the fluid-bed immersion step with an annealing stage in order to cause the adhering powder particles to fuse into a continuous coating. The need for this annealing step depends principally on the plastic materials employed for coating: in the case of polyethylene, residual heat in the object removed from the fluid-bed bath is frequently enough to cause adequate fusion and flow of the deposit, while nylon 6 and some other resins make an aftertreatment necessary.

The Plastic Powder

During the early years of the process' development, commercial work was confined principally to coating with low-density polyethylene and nylon 6 powders. Principal early interest in polyethylene was for its corrosion resistance, while nylon was applied chiefly for its wear resistance characteristics. For both of these materials

Production model fluidizers.

(Courtesy Michigan Chrome and Chemical Company)

Fluidized plastic installation for coating transformer covers. Fluidized powder is kept in enclosure at left; coating ovens are at the right.

(Courtesy Westinghouse Electric Corp., Athens, Ga.)

fluid-bed technique proved a fruitful method of coating because application by solvent techniques is not possible.

Impelled by the activity and even greater prospects for the fluid-bed coating technique, the line of plastic powders available for this application has been significantly expanded during the last 2-3 years although commercial work was confined principally to coating polyethylene, nylon 6 and nylon 11 (the latter especially in France), vinyls, and some celluloses. Each of these coatings has its special areas of commercial interest which will be discussed below.

However, the gamut of available plastics powders extends well beyond these established products. As a result, fluid-bed coating is now on the way toward becoming a highly versatile tool for surface finishing. All of these powders have a few physical properties in common which are called for by the engineering characteristics of the fluid-bed system, i.e., its hydrodynamics and interaction between the object to be coated and the plastics powder at a temperature near its fusion point.

Of key importance among these mechanical characteristics which determine a powder's fluidizability (50-150 mesh for operating conditions normally encountered in coating technology), are moisture content (which must be low, as must be the humidity of the carrier gas fed into the fluid-bed vessel through a porous plate), and electrostatic charge. Presence of a slight electrostatic charge in the plastics particles will assist not only in adhesion to the surface in process but will help prevent agglomerization of particles (since their like charges will tend to repel each other) and will thus reduce the incidence of non-uniform coating. Also to prevent agglomerization, as well as to meet the hydrodynamic demands of the fluid-bed system, the resin particles should be almost perfectly spherical in shape.

A sample test to determine the ability of a particular powder to be carried in a fluid-bed is to determine the angle of repose of a small mound of the powder on a clean flat plate. In general, fluidization will be possible if the powder begins to flow when the flat plate is inclined at an angle of 45° or less with the horizontal. Similarly, simple tests have been developed for determining the optimum coating temperature in fluid-bed work (see, for example, C. J. Metz's paper given to Society of Plastics Engineers, May 22, 1959).

Both thermosetting and thermoplastic resins have been employed for fluid-bed coatings. In the former group, the greatest interest attaches to epoxies which have been applied by contacting them in fluidized form with the preheated article to be finished.

However, the really significant potential of fluid-bed coating techniques is in the field of coating with thermoplastics. The following thermoplastics resins have been applied successfully as coatings by fluid-bed technique: polyethylene (branched and linear, filled and unfilled), nylon, fluoro-carbons, cellulosics (i.e., esters), plasticized vinyls, methacrylates, polystyrene, and acetals. To this list must be added chlorinated polyethers and polypropylene. Within each of these main categories, there are several sub-formulations and an increasing range of color is becoming available.

Applications

From the processor's point of view, a particularly important aspect of fluid-bed coating is adaptability of the same technique and equipment for any of the available resins. However, this versatility is tempered by the need to define exact operating conditions (preheat temperature, exposure time, density of fluid-bed) for each resin and article individually. For these reasons, and because of its high coating speed and good materials efficiency, fluid-bed technique is thus particularly suitable for use in mass-production runs — which may, however, be of relatively short duration.

Generally speaking, the leading commercial use for fluid-bed coating at present is in the decorative and decorative-protective fields, with a wide variety of base surfaces ranging from metals to glass and steel, and even to plastic substrates (which must, however, have a softening point at least 40-45°C. above that of the coating material).

A more recent but very important development is use of the technique to apply electric insulation (e.g., Westinghouse Electric Corp. employs the method to apply epoxy coatings to toroidal tape-wound cores). Still of minor importance, but rapidly growing in importance is the use of fluid-bed methods to provide coatings characterized by high-corrosion resistance

(e.g., for the chemical industry), wear resistance and low coefficient of friction.

Specific fields of application predominate for each of the principal types of plastic powders now available for fluid-bed coating purposes. In the case of polyethylene, the emphasis is on protective coatings; because this is essentially a new application for polyethylene, many of its uses are also novel. Nylon is employed for coatings in which a premium is placed on good chemical resistance.

Chlorinated polyether, recently introduced in powder form, is valued for outstanding heat, water, and chemical resistance. Cellulose ester coatings are applied by fluid-bed technique for uses where good appearance, toughness, high impact resistance must be outstanding. Polyvinyl chloride — the latest arrival to fluid-bed thermoplastics — is making its mark in competition with conventional vinyl coatings with the same favorable combination of low price, good electrical properties, chemical resistance, and versatility. Epoxies are favored for good electrical properties, good corrosion resistance and toughness. Fluorocarbons, of course, exhibit outstanding chemical resistance.

Some specific examples will indicate the range of products which are being coated by various plastics in fluid-bed technique, or which may be profitably finished in this manner:

Polyethylene: fan blades and housing, baskets and pans for pickling equipment, bathroom soap trays, towel rails, clothes hangers, glass vials, display store shelves, baskets, racks and trays for refrigerators, dishwashers and washing machines, back-up flanges, pipe hangers, machine components.

Nylon (principally type 6): sliding surfaces (e.g., in control valves, hinge pins), steel rolls for offset printing.

(Courtesy Westinghouse Electric Corp., Athens, Ga.)

After coating operation, excess powder must be blown off. The coated piece is then baked.

(Courtesy Michigan Chrome and Chemical Company)

Articles coated with powdered resins by the fluidized bed process.

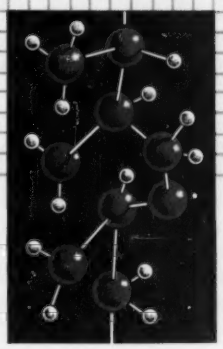
Cellulosics and vinyls parallel to a certain extent the general fields of application for polyethylene. In addition, cellulosics and vinyls as well as *epoxies* are applied by fluid-bed technique to electrical components — stators, rotors, coils, cores, distribution transformers, etc. Cellulosics are also their mark in decorative applications for inexpensive outdoor use (metal furniture, flower pot holders, etc.). *Fluorocarbons* are of particular interest in fluid-bed coatings of intricately shaped, small articles intended for use in highly corrosive areas, i.e., particularly in the chemical industry.

Problems

The extent of future growth of the fluid-bed coating technique will depend on the rate at which several remaining engineering and commercial problems can be solved. There is still need for greater mechanization, a wider range of commercially available plastics powders, plus better adhesion performance of the applied coating. Furthermore, problems occur due to the need to tailor conditions to the particular lot being processed (this includes material selection, temperature control, analysis of the object's thermal characteristics), residence time in the coating bath, method of preheat control and after-treatment, method of handling the object itself.

In each application, an Achilles heel occurs; i.e. there is no coating at the point where the object is held during its immersion into the bath. A special after-coating step (e.g. applying some resin followed by a hot air blast) is needed to cover this small point of contact. Finally, there are safety problems in handling the fine powders called for by the process.

Plastics and equipment suppliers are collaborating actively with coating applicators in developing guide lines and techniques which will resolve these remaining problems in fluid-bed coating technology.



SYNTHETIC RESINS

The Backbone of Modern Finishes

A SURVEY OF THE LATEST DEVELOPMENTS IN SYNTHETIC RESINS USED IN COATINGS

Part VI - Epoxy Resins (Section A)

By Harold P. Preuss

This is the second and concluding installment of Part VI (Section A) of the series on Synthetic Resins. The first half appeared in the December 1960 issue.—*Ed.*

Amine-catalyzed epoxy coatings can be cured without heat. Lower molecular weight epoxies, such as *Epotuf 6301*, are usually used, although coatings are presently being developed which employ liquid resins and little or no solvents. There are three types of amine curing agents used — aliphatic amines, amine adducts and polyamides. The epoxy and amine portions are not mixed until ½ to 1 hour before application. The mixture has a pot life of from 1 to 3 days, depending on the amine used, solids content, solvent and temperature. The aliphatic amines used are primary and secondary polyamines. They are, in order of increasing molecular weight, ethylene diamine, diethylene triamine, triethylene tetramine, and tetraethylene pentamine, at the rate of 6 parts per 100 parts *6301*. As the molecular weight of the amine is increased, the speed of cure decreases, toxicity decreases slightly, and sensitivity to water decreases. The amine-cured epoxy coatings will dry tack free in 5-7 days, or more rapidly if baked. They develop a hardness and abrasion resistance that equals many baked finishes, have good adhesion and flexibility, and are not far below baked epoxy finishes for chemical and solvent resistance. They may be pigmented by dispersion in the epoxy solution, but zinc oxide and zinc chromate pigments should not be used, as they will react with aliphatic amines.

Aliphatic amines have certain disadvantages — they are sensitive to humidity, and are difficult to mix because of the small proportions used. To overcome these defects, amine adducts have been developed. One such adduct can be prepared by reacting *Epotuf 6301* with an excess of triethylene tetramine. Proportions are 238 pounds *6301*, 95 pounds TTA, 231 pounds xylol, 231 pounds methyl isobutyl carbinol. *Resin 6301* reacts with about 15% of TTA, the remainder being available for further reaction with epoxy resin. An adduct of this type is used in proportions of approximately 50 parts per hundred of resin, and is less toxic and water sensitive than amines. Coatings made with adducts are very similar in properties to those made with aliphatic amines.

Versamids 100 and 115 may be used with *Epotuf 6301* for two-can coating systems. They have several advantages over aliphatic amines — they are non-toxic, produce better flow, higher gloss, better adhesion, better flexibility, better blush-resistance, and somewhat longer pot life. On the other hand, they have poorer color, poorer solvent resistance, and somewhat slower dry. The ratio of *Epotuf 6301* to Versamid 100 used is usually 50/50 to 60/40, and of *6301* to Versamid 115 is 60/40 to 70/30. Versamid 100 usually produces better flexibility while Versamid 115 produces better hardness and resistance. Either the epoxy or Versamid portion can be pigmented, preferably the Versamid portion as it has excellent wetting properties. Zinc oxide and zinc chromate pigments can be used with epoxy-Versamid vehicles, but must be dispersed in the epoxy resin portion, not the Versamid portion. An interesting feature of epoxy-Versamid coatings is that they can be brushed onto damp surfaces including fresh concrete, since the Versamid will emulsify with water under brushing action, releasing the water as part of the solvent.

Amine and Versamid cured epoxy coatings can be applied by brush or spray at 40-50% non-volatile content for a wide variety of uses, including appliance finishes, tank and drum linings, and maintenance finishes for metal, wood and concrete. As maintenance finishes, they are far superior to air-drying oleoresin-

ous and alkyd coatings for chemical resistance, abrasion resistance and adhesion.

Epoxy esters are produced by esterifying epoxy resins, such as *Epotufs 6304* and *6307*, with linseed, soya, dehydrated castor or other fatty acids. Rosin and phenolic resins may also be incorporated, and styrenated esters have been produced with the addition of styrene. A wide variety of esters can be produced depending on (1) ratio of epoxy to fatty acid, (2) type of epoxy, (3) type of fatty acid, and (4) degree of modification with other resins. Epoxy esters are soluble in aromatic or, in some cases, aliphatic solvents. They can be used either as clears or pigmented, as one-component air dried or baked finishes, in a manner similar to alkyds and oleoresinous varnishes. Driers are added for air dried or baked finishes, while urea or melamine resins may be added for baked coatings. Epoxy esters are intermediate between unmodified epoxy coatings and alkyds for such properties as chemical resistance, adhesion, abrasion resistance and cost. They can be used either alone or modified with alkyds to produce superior floor coatings, maintenance enamels, primers and industrial finishes.

Dow Resins

The Dow Chemical Company likewise manufactures a line of epoxy resins which may be broadly classified as being of the liquid or solid (hard) types. The liquid resins are known as *D.E.R. 331*, *D.E.R. 332*, and *D.E.R. 334*. Their properties were given in Table 1. Typical uses are shown in Table 3.

TABLE 3

Typical Coating Applications for Dow Epoxy Resins

Liquid	*Solid*
Electrical Insulating Varnishes	Air dry and baking industrial finishes
Solvent free coatings for metal protection:	Industrial floor coatings
Pipe lining	Enamels for household equipment
Tank lining	Electrical insulating varnishes
Can lining	Can, drum and pipe linings
Concrete coating and patching compounds	Wire coatings

Resin 331 is a low molecular weight liquid epoxy resin. Where lower viscosity is required and high temperature performance is not required, this resin may be blended with various reactive diluents.

Resin 332, because of its chemical purity and lack of higher polymers, assures uniform performance, extremely low viscosity without diluent addition, long pot life, and high heat distortion temperatures. Cured with appropriate hardeners, it finds use in exceptionally colorless gel coatings, in potted electrical components, etc. The resin is so pure that it may crystallize at room temperatures. However, its physical properties are not affected and it readily returns to a liquid state upon rewarming to approximately 125°F., while stirring gently. This crystallization is a phenomenon of resin purity and should not be confused with hardening or curing. Virtually colorless cured systems can be obtained with D.E.R. 332 by curing the resin with any colorless hardener that will produce a low exotherm. Meta xylylene diamine* is an example of such a curing agent.

Resin 334 is Resin 331 modified by the addition of butyl glycidyl ether (BGE).** This lowers viscosity and permits high filler and pigment loading to achieve special properties and to reduce costs. The use of reactive diluents such as BGE tends to lower heat distortion temperatures.

These resins accept a wide range of fillers. This enables the epoxy formulator to reduce costs, to develop desired properties, and to adjust handling characteristics. Among the fillers commonly used are clays, asbestos or glass fibers, powdered metals, aluminum oxide, silica, mica, and powdered glass. Although these liquid epoxy resins are ordinarily insensitive to fillers, the curing agents may react with certain filler materials. Therefore, non-reactive and neutral materials are commonly used in epoxy compositions to prevent extreme property changes. Fillers also are used as dyes or pigments to impart color to the final product. Some dyes, however, may not be stable when used in conjunction with amine-type curing agents. Some examples of effects which can be gained by filler addition are as follows:

1. Thixotropic effects, which reduce resin flow and drain from vertical surfaces, can be obtained by adding 1 to 7% of certain silica gels and silicates into liquid resins.
2. Aluminum powder at high percentages is used to increase thermal conductivity, to decrease exotherm, and to improve machinibility.
3. Aluminum oxide increases the abrasion resistance of epoxy castings.
4. Epoxy castings containing silica sand are extremely hard.
5. Ordinary fine grain sand is an economical filler for non-critical applications.

Resinous modifiers based on melamine, urea, phenolics, polyamides, resinous polyols and polyglycols, may act as curing agents for epoxy resins through reaction with the epoxide groups or the hydroxol groups. In such cases, the cured casting will reflect some properties of the modifying resin, as well as typical epoxy properties.

Solid epoxy resins made by Dow are know as *D.E.R. 661*, *D.E.R. 664* and *D.E.R. 667*. Their properties are given in Table 1. In Table 3 are listed typical uses for these solid type resins.

Resin 661 is supplied both as a solid resin and in solution. Its high melting point yields a significant advantage: the flaked resin has little tendency to block or lump during summer storage. This resin is designed for use in amine-cured coatings and in laminates which are impregnated from solvent solution. Certain formulations with D.E.R. 661 can be sprayed from double nozzle guns developed for 2-can epoxy systems; other formulations are easily brushed, rolled, dipped, or

*Oronite Chemical Company.
**The Dow Chemical Company.

poured. Room temperature cured coatings, baked coatings, dry lay-up laminates, fluidized bed coatings, adhesive coatings are a few typical examples of end uses for the resin.

Cure schedules for D.E.R. 661 formulations vary with the type and amount of curing agent employed; they also are affected by other formulating additives and, to some extent, by the solvent used. Baked cures require shorter cure times and develop better properties than do air-dry cures. The cure schedule shown in Table 4 is indicative of curing conditions which may be utilized.

TABLE 4
Typical Heat Curing Schedule for Amine Cured Dow Resin 661

Air Dry	4 to 6 hours to handle; 3 to 7 days for full cure
200°F.	20 minutes
250°F.	15 minutes
300°F.	10 minutes
350°F.	5 minutes

(Slightly higher temperatures or longer bake schedules are suggested for Versamid-modified solutions.)

Resin 664 is a general purpose coating resin especially suitable for esterification with drying oil fatty acids to form esters having a wide range of properties. An advantage in using this resin is the fast drying time of some of its fatty acid esters. These have outstanding chemical resistance, and good adhesion, hardness and flexibility. The fatty acid esters of Resin 664 are compatible with many other coating materials; the modified epoxy esters form coating vehicles suitable for a broad range of applications. In many instances they are applicable where alkyd resins are now being used if that application justifies the increased cost which accompanies the better properties of an epoxy coating.

Resin 667 is the highest molecular weight solid epoxy resin made by The Dow Chemical Company. Because of the resin's high molecular weight and because it is typically bake-cured with relatively small amounts of heat-converting phenolic, urea, or melamine resins, Resin 667 finishes develop ultimate "epoxy" properties of chemical resistance, adhesion, hardness, flexibility, and abrasion resistance. Resin 667 may be reacted with drying oil fatty acids to form esters suitable for use in relatively inexpensive coatings. This type of coating is noted for good flexibility and chemical resistance. Finishes based on this resin are suitable for metal decorating, appliance primers and finishes, interior and exterior can coatings, drum liners, etc. Bake schedules for Resin 667 formulations

TABLE 5
Typical Bake Schedule for Resin 667 Cured with Amino Resin

250°F.	60 minutes
300°F.	30 minutes
350°F.	15 minutes
400°F.	5 minutes

TABLE 6
Typical Bake Schedule for Resin 667 Cured with Phenolic Resin

300°F.	60 minutes
350°F.	30 minutes
400°F.	15 minutes
450°F.	5 minutes

will vary, of course, with type and amount of resin employed, and the kind and ratio of other formulating additives. Tables 5 and 6 show variables of time and temperature at which comparable degrees of cure may be obtained.

A new epoxy resin produced by Dow is called *D.E.N. 438*. This resin combines excellent thermal stability with good chemical resistance and adhesion. It consists of a phenolic structure combined with an epoxide. Any hardener or curing agent used with conventional bisphenol A epoxy resins will cure this resin. Promising coatings made with D.E.N. 438 resin include partial ester types, amine-cured solution types, high solids coatings, and fluidized bed coatings.

Experimentation is going forward on three experimental Dow flexible light-colored, low viscosity fluid resins. These are straight-chain diglycidyl ethers of varying molecular weights. Their function in improving flexibility is that of providing a long chain, innately flexible polymer throughout the otherwise densely crosslinked, cured epoxy mass. Their use, however, sometimes results in lowered water and chemical resistance. The three resins have been designated *X-2673.2, X-2673.6* and *X-2674*. By a small margin, Resin X-2673.2 is the most efficient flexibilizer on a weight basis. The high viscosity of Resin X-2674 is sometimes offset by improved properties of systems cured with methylene dianiline, MNA, or PMDA. With these three hardeners, X-2674 contributes outstanding toughness. In D.E.N. 438 systems, Resin X-2674 performs well, but it usually cannot compete with the more convenient diluent action of X-2673.2. Resin X-2673.6 is moderately effective as a flexibilizer. It might be even more useful as a low volatility, low viscosity, reactive diluent, ignoring its flexibility contribution at low concentrations.

* * * *

Next month's article will discuss epoxy resins made by several other United States manufacturers.

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FINISHING POINTERS

Rhodium Plating Costs

By J. Newton Perham

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RHODIUM plating costs approximately $0.21 per sq. ft. for every millionths of an inch of deposit thickness. Considering the advantages of its hardness, tarnish resistance and chemical stability, this cost is not prohibitive. To realize the benefits, however, it is most important that an electroplater control the amount of rhodium that is deposited during production plating.

The equipment necessary for checking the thickness of a thin rhodium plate is expensive and is usually not available to the average plater. The following method of determining and controlling the rhodium plate thickness gives fairly accurate results, providing the tests are run at periodic intervals. It is based upon the determination of the cathode efficiency of the bath at the current density normally used in production plating. This procedure utilizes an analytical balance with a sensitiveness of 0.1 mg. and several discs or plates with holes in their surfaces for racking. For convenience in handling, the discs selected were 1" dia., 0.005" thick and weighed approximately 0.5 gram. The pieces may be made of nickel, silver, or nickel plated non-ferrous metal.

The discs are weighed, their weights recorded, and are then rhodium plated. It is important to maintain the same current density that is used normally in production. This figure in amps./ft.^{2} can be obtained as follows:

1. Actual current in amperes =

$$\frac{\text{area in sq. in. of work surface} \times \text{amp./ft.}^2}{144}$$

Place at least 5 discs in different locations around the rhodium tank. Plate the 5 pieces for a minimum of 5 minutes. The discs are weighed again and the information is recorded. The total weight of rhodium plated on the 5 pieces is now available. Substitute this figure in equation #2 and the efficiency of the rhodium bath is determined.

2. Plating time in minutes =

$$\frac{60 \times \text{wt. of Rh deposited in grams}}{\text{bath efficiency} \times 1.28 \times \text{actual amperes}^*}$$

With the bath efficiency established, the amount of rhodium plated on a production item can then be calculated. Make sure that the same current density is used in all operations.

3. Weight of Rh plated in milligrams =

$$\frac{\text{area in sq. in.} \times \text{thickness of plate in inches}}{**0.000005''}$$

4. Cost of Rh deposited =

$$\frac{\$0.21 \times \text{area in sq. in.} \times \text{thickness of plate in inches}}{144 \times 0.000001''}$$

Calculations

Let us now figure the plating time required plus the cost of rhodium used on a production item of 100 sq. in. surface area.

The rhodium solution is a 2 gram per liter, phosphate bath operated at 120°F. The piece requires 0.000003" of rhodium deposit and plating current density is 50 amp./ft.^{2}

To establish the efficiency of the plating solution, five 1" dia. numbered and punched nickel discs are weighed. Total weight 2.5184 g. Total disc area to be plated is 7 sq. in. The pieces are racked in the tank and plated for 5 minutes at 50 amp./ft.^{2} or 2.4 amp. actual current, based upon equation #1

$$\text{Current} = \frac{7 \times 50}{144} = 2.4 \text{ amp.}$$

Total weight after plating is 2.5388 g., or 20.4 mg. of Rh plated. Using equation #2 it is determined that the bath efficiency at 50 amp./ft.^{2} is 8%.

$$\text{Bath efficiency} = \frac{60 \times 0.0204}{5 \times 1.28 \times 2.4} = 8\%$$

It is now possible to figure the necessary plating information for the production item.

1. Actual current to plate piece =

$$\frac{100 \times 50}{144} = 35 \text{ amp.}$$

2. Weight of Rh plated =

$$\frac{100 \times 0.000003}{0.000005} = 60 \text{ mg.}$$

3. Plating time $\dfrac{60 \times 0.06}{0.08 \times 1.28 \times 35} = 1$ minute

4. Cost = $\dfrac{0.21 \times 100 \times 0.000003}{144 \times 0.000001} = \$0.44$

Armed with the above information, a manufacturer is able to figure his costs and, at the same time, feel confident that he is producing a properly finished article.

*1.28 is the weight of Rh deposited with one amp. hr. at 100% efficiency.

**0.000005" is the thickness of 1 sq. in. of Rh surface weighing 1 mg.

Science for Electroplaters

62. Adhesion Tests

By L. Serota

This is the second and concluding installment of Part 62 of the series by Mr. Serota. The first half appeared in the December 1960 issue.—*Ed.*

Jacquet Test

In his investigation of the effect of colloids on the adhesion of electrodeposited metals, P. A. Jacquet devised a method of determining, quantitatively, the bond strength in pounds per sq .in. The principle entails the deposition of a metal on a basis metal so that one end does not adhere; hence, when lifted, it will provide a handle which, when attached to a suitable device, will pull (detach or peel) the plated surface from the basis metal. Fig. 6 represents a modified device used by H. B. Linford and A. Venkateswarlu for adhesion testing by the Jacquet method.

An adaptation of the Jacquet test was introduced by Brenner. Instead of providing a grip or handle by dipping one end of the strip to be plated into a colloid solution, the end of the steel strip, it is suggested, may be coated with a poorly-adherent layer of gold or silver, as a means of providing a peeling region. For plated surfaces, the following procedure is given: a part of the surface is removed by machining, or with emery paper, prior to plating with a thick layer of nickel. Since nickel will not adhere firmly to the machined or emeried part of the surface, an area is provided for lifting the deposit.

Results obtained with nickel deposits up to 0.05" thickness on different basis metals, from a warm bath, are recorded in Table 6. A 600 pound Amsler testing machine was used to measure the force for peeling the deposit. The values represent the force in terms of kilograms (kg.) per centimeter (cm.) width, with a one centimeter strip usually peeled.

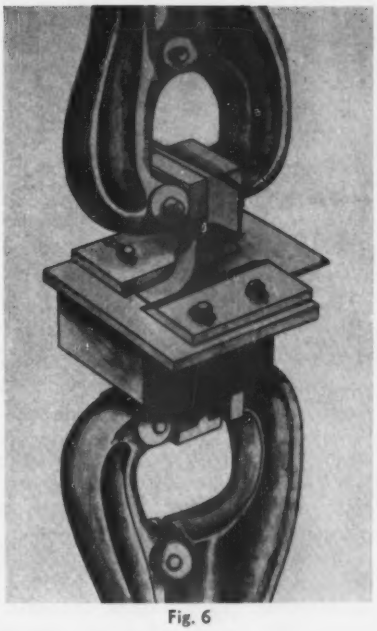


Fig. 6

TABLE 6
Adhesion of Nickel Coatings by Jacquet Method

Basis Metal	*Peeling Force Kg/cm*
Cast Iron	3
Malleable Cast Iron	25
Extruded Brass	90
Cast Brass	150
Nickel Brass	150

Additional studies on the effect of thickness of the deposit showed that the peeling force and amount of basis metal removed increased with the thickness of the coat. For example, a nickel deposit 0.016" thick on cast brass required a peeling force of 100 kg./cm. and 0.018 g./cm.^{3} of basis metal was removed, whereas, a thickness of 0.031" nickel deposit on the same type basis metal required a peeling force of 180 kg./cm., with 0.035 g./cm.^{3} basis metal removed. Deposits of 0.10", 0.029", and 0.054" of nickel on copper required corresponding peeling force of 50, 90, and 135 kg./cm.; with 0.017, 0.030, and 0.054 g./cm.^{3} basis metal removed respecticely. The results are attributed not so much to the increased thickness of the deposit as to the radius of bending, which will vary at the point of detachment with the thickness of the coating and the greater amount of basis metal removed, possibly, with the stress at the interface. This modified Jacquet test, accordingly, was not considered by Brenner to be entirely satisfactory.

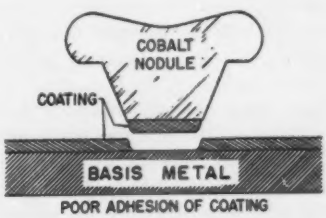
Nodule Test

In an effort to overcome the difficulty encountered in adhesion tests of providing an adequate gripping device for thin deposits so that detachment from the basis metal will be satisfactory, A. Brenner and V. D. Morgan devised an electroformed, adherent, mushroom-shaped projection (nodule) to serve as a grip for detachment on the surface of the deposit.

Small areas $\frac{1}{10}$" in diameter serve as spots for depositing such nodules on the otherwise masked surface of the deposit. The built-up nodules are then gripped in a chuck and the force required to detach the nodule with the coating is measured by a spring. To express results in pounds per sq. in., the area of the nodule must be measured. If the degree of adhesion is high, some of the basis metal will be included in the detached part.

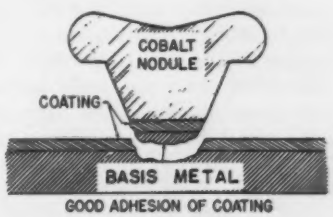
This effect is represented diagrammatically in Fig. 7a, indicating poor adhesion of deposit (coating) with separation occurring at the interface; and in Fig. 7b good adhesion of plate with rupture of basis metal shown.

A cobalt chloride solution was found to be most satisfactory for electroforming nodules. This bath, however,



POOR ADHESION OF COATING

Fig. 7A



GOOD ADHESION OF COATING

Fig. 7B

will not give a sufficiently adherent deposit to a coating of bright nickel for an adhesion test. A nickel chloride solution required too long a period for building up nodules. Copper deposits from copper sulphate or copper fluoborate baths or from alkaline pyrophosphates were not satisfactory. Deposition from the cobalt chloride bath is best attained at a temperature of 167°F. (75°C.) and a pH of 4 to 5. A sulfonated aryl type wetting agent is added (0.067 oz./gal.). The current density range recommended is from 0.13 to 0.65 amp./in.^{2} or 0.25 to 1.3 amperes per specimen. The solution is agitated during electrolysis, and best results for nodule buildup will occur if the bath is operated for about 16 hours (overnight).

To determine the validity of the nodule method for measuring adhesion of thin coatings, a comparative study was made of the tensile pull required to detach the nodule from deposits sufficiently adherent to rupture the basis metal in the process, with that of the tensile strength of the basis metal. Results indicated that, although the force required to detach the nodule varies (some higher, others lower) from the tensile strength of the basis metal, the order of magnitude is correct. The variations in value are attributed either to actual conditions or, possibly, differences in strength of the surface and bulk of the basis metal.

H. C. Schlaupitz and W. D. Robertson used a modified form of the Brenner method. By eliminating high stress concentration at the base and allowing symmetry at the interface, requirements for the quantitative measurement of adhesion of electrodeposits are met more satisfactorily. This was accomplished by using similar electroformed cylindrical nodules on electrodeposits on both sides of the basis metal. Deposit and basis metal, it is recommended, should be thin to reduce plastic deformation. A schematic diagram is represented in Fig. 8.

The nodules are $\frac{1}{16}$" in diameter and have a stem $\frac{1}{16}$" in diameter. Nickel nodules were electroformed from a standard nickel chloride bath ($NiCl_2 \cdot 6H_2O$, 300 g./l.; H_3BO_3, 30 g./l). Annealed copper foil 0.003" thick, grain size 0.025 mm., chemically activated, was used initially as the basis metal. The nickel bath was operated at 24 amp./ft.^{2}, at 130°-140°F. and a pH of 4.0-4.5. Nodule formation requires about 4 days. Results obtained with nickel nodules electroformed on one

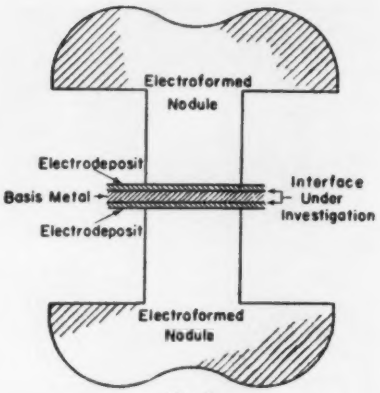


Fig. 8

piece of copper foil showed that fracture occurred entirely in the copper foil, indicating, the authors note, a greater adhesive strength between the nickel deposit and copper foil than the fracture strength of the copper foil. Results of the fracture stress, in pounds per sq. in., for the aforementioned 5 samples are given as 46,900, 41,100, 46,100, 31,400, 46,800 respectively. Fracture strengths for three of the nodules: 46,900, 46,100, 46,800 gave reproducible values which averaged 46,600 psi which, they note, compares favorably with the recorded fracture value of 48,000 for copper wire. The low fracture strength values for the other two nodules is not clear and, it is suggested, require additional study.

FOREIGN LITERATURE

Coloring Anodized Aluminum for Building Construction

C. T. Speiser: *Aluminium* (Duesseldorf-Germany), **36,** 91.

The author discusses the light-stability of the colors employed for finishing anodized aluminum building parts. Inorganic gold tones of sufficient light-fastness can be produced by the process which precipitates ammonium-ferric oxalate. Under very severe laboratory test conditions however, even this color shows itself to be incompletely light-fast. Any shading of the color tones towards yellow or red is not practical. Building construction parts in Germany have now, for some years, been colored with the Elan gold process and have produced no objections.

Bronze tones produced by inorganic processing means are generally obtained by the double reaction of two different metal salts. A suitable reaction for example, is that employing cobalt acetate and potassium permanganate. With a correct procedure bronze colors of good tone and uniformity can be produced. With a subsequent after-treatment with pyrogallol, a certain shading of the color-tone can be achieved. The light-fastness is good.

In addition to the above, bronze tones can be produced by organic-inorganic means. A known process consists in slowly passing a substance which reacts with albumen over the anodized oxide surface. The aluminum is then treated subsequently with potassium permanganate. The light-fastness of this coloration is good. It is recommended to apply this treatment onto anodized oxide coatings of 20 to 30 microns in thickness.

A relatively large choice of organic dyestuffs are available today to the technician. With regard to their light-fastness and weather resistance, these dyestuffs hardly come up to the characteristics of the inorganic colors. These characteristics depend not only on the nature of the dyestuffs but, to a great extent, also on the conditions under which they are applied. Also, purity of the surface, oxide coating thickness, concentration of the dyes solution, pH, nature of the after-sealing. Full processing details for the color treatments are given in the text.

Inhibitor Action in Electroplated and Electroless Nickel Deposition

J. Elze: *Metall* (Germany), **14,** 104 (1960).

The author investigated the influence of various inhibitors on nickel and hydrogen deposition during nickel deposition. Statements and postulations were given with regard to the inhibitor mechanism, obtained from the time sequence of the overvoltages (0-t curves) employed for the determination of the initial-current voltage curves. For electrodeposition, the author used a Watts bath.

The organic inhibitors used, with cathodic loading of the electrode, raise both the polarization association with the nuclei formation as well as the stationary polarization figure. A more compact metal deposit is formed, i.e. one which covers the cathode (electrode) surface without pitting or holes;

if under the same conditions, the increase of the polarization through the inhibitor does not exceed about 25—30 mv. Up to about 110 mv. a compact deposit is still formed, whose internal stresses, however, cause it to part away from the sub-surface. With strong increase in polarization, the cathodic current efficiency of metal deposition falls.

The addition of inorganic crystallization inhibitors as against the organic ones, has the advantage that no uncontrollable breakdown product is formed. It is questionable, however, as to how the inclusion of metals such as cadmium and lead act on the corrosion-behavior of the deposits.

For the tests conducted on the electroless nickel deposition the following bath composition was used:

Nickel sulfate	270 g./l.
Nickel chloride	50 "
Boric acid	30 "
Sodium hypophosphite	10 "

Organic inhibitors first accelerate the metal separation and, accordingly, lead more quickly to exhaustion of the solution; the maximum coating thickness is reached earlier. The hydrogen separation is more strongly restricted by the inhibitors than the nickel separation. The characteristic of the 0-t curves without addition and with moderate inhibition by organic inhibitors is somewhat the same.

Added metal ions also such as cadmium, lead, and copper in low concentrations restrict the hydrogen separation more strongly than the nickel separation. The added metals are co-deposited in part.

Metalizing and Plating of Plastic Parts

R. Uebigau: *Kunststoffe*, **49**, No. 1, 45.

A number of processes for metalizing plastic parts have been developed. These comprise: evaporation and deposition of the metal coatings in a vacuum; reduction of an applied silver nitrate solution to metallic silver; chemical nickel-coating; application of an electrically conductive lacquer or graphite and subsequent plating. These processes are, in part, somewhat expensive and are not free from various drawbacks.

The plastics industry has now created new processing possibilities by the development of plastic molded parts which can be electroplated directly. In the place of the usual fillers, in the case of phenol resin mouldings for example, up to 50% of lampblack or graphite is co-mixed in with the plastic and, accordingly, the former well-known dielectric characteristics of the plastic are changed to produce a body which is electrically conductive. Metallic additions would change the characteristics of the plastic too greatly, for example, the specific gravity.

From experience, it is found that the surface skin of injection molded plastic parts of this type is enriched in resin and this must be removed to improve the electrical conductivity. Accordingly, the parts are immersed for 1 hour in a 40% caustic soda solution. The surface skin can also be removed by sand-blasting with not-too-coarse emery powder.

The following bath is recommended for cleaning and degreasing: 15 g./l. soda; 15 g./l. sodium orthophosphate; with the addition of a commercial wetting agent. The bath is worked at 10 volts for 3 minutes, cathodically. To plate phenol-resin plastics, only acid plating baths should be used because the resin is not sufficiently resistant when immersed in alkaline baths. As the metallic base coating, copper should be applied from a good bright copper bath with satisfactory throwing power and leveling action.

The electrical conductivity of conductive phenol resin plastic mouldings of this type is naturally inferior to that of metal parts. Accordingly, at the beginning of the plating procedure, the current density should not be set at the values normally used for plating metal parts, but at a lower value.

Care should further be taken that the contact places show no appreciable transition resistance. If careful attention is not paid to this, local "burning" can occur at the contact areas.

The Phosphoric Acid — Chromic Acid Bath for Electropolishing Steel and Aluminum — Japanese Practice

Metalloberflaeche, **14**, No. 8, 248.

Phosphoric-chromic acid solutions cannot be operated with a.c. current as the rapidity of the reduction of the hexavalent chromium to the trivalent, is too great. This reduction process also occurs when the bath is operated with d.c. current and shortens the working life in comparison with similar electropolishing electrolytes which are free from chromic acid. On the other hand, chromic acid gives a good polishing effect, so that ways have been sought to prevent this reduction or to re-oxidize the trivalent chromium. Potassium persulfate can be used, or the bath can be worked with lead dioxide anodes. Both methods have been found satisfactory in Japan. However, prevention of the reduction by a diaphragm which surrounds the cathode appears to be a more practical solution.

A simple machine for electropolishing steel needles is described. A revolving disc of soft steel, half-immersed in the bath is used. The sides of this disc are covered with an acid-resistant, insulating lacquer. This disc is set close to an induction coil which renders it magnetic. The tank is made from a non-magnetic material. The parts which are fed on to the disc adhere magnetically, are carried into the electropolishing bath by rotation (the disc is belt-driven) and are anodically polished. With two workers, a daily output of 60,000 to 80,000 needles can be electropolished and subsequently chrome-plated in a similar apparatus. This principle of magnetic racking (hanging) is also made use of in Japan for electropolishing clock parts. Sewing machine needles, for which this process was specially developed, not only have a better appearance, but are also simultaneously sharpened and their rubbing resistance to textile materials is reduced. With subsequent chrome-plating, the needles glide very well in use. They have a longer life in use; with industrial sewing and weaving needles, this is particularly important. In addition it should be mentioned that the corrosion resistance is also raised.

Good electropolishing results were achieved under the following conditions:

Phosphoric acid	800 grams
Water	200 cc.
Chromic acid	250 grams
Voltage	8-10 (d.c.)
Temperature	90°C.

If the cathode is arranged within a porous cell, the reduction of the hexavalent chromium is greatly lessened and the life of the bath can be tripled.

SHOP PROBLEMS

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Anodizing 24SO Aluminum

Question: We are anodizing heat-treated parts stamped out of 24SO aluminum with a copper content of 3.8 and the silicon content is 0.50%. Our customer is desirous of a clear bright anodized finish and the difficulty we encounter is that in the anodizing process the bright finish is made dull despite the fact that the parts are bright before anodizing (cloudy and hazy).

The procedure we employ is degrease, immersion clean, rinse, bright dip, rinse, desmut, double rinse and anodize at 12 volts 15 amp./sq.ft. for 15-20 minutes and seal in hot water. The electrolyte used is 15% sulphuric acid. The parts are bright and have a satisfactory luster before the anodic treatment. We have also tried the etch cleaner instead of the immersion but it made no difference. Are we expecting something that cannot be done as we have tried most everything in the way of procedure? Electropolishing gives better results but the cost is prohibitive.

H. G. S.

Answer: A clear bright anodized finish is not quite attainable on this alloy, although improvement is possible by cutting down on the anodizing time. The operating voltage is satisfactory. The cloudy appearance of the anodized surface can be minimized by a light buffing operation.

Gold Over Nickel

Question: Can you give me any information on whether a (cyanide) bright gold can be plated over a bright nickel plate (acid).

M. S.

Answer: Cyanide gold is commonly plated over bright nickel. However, if the work is allowed to lie around after nickel plating, even under water, the nickel surface becomes passive and may not take a satisfactory plate. In this case, striking in a regular cyanide gold flash solution will be effective.

Sand Bobbing

Question: Will you kindly forward, as soon as possible, any information you may have or such literature as may be applicable, to Sand-Bobbing. We require knowledge of speed (after silver plating), grit of sand, oil, etc.

D. G.

Answer: Sand bobbing is used prior to silver plating, not after plating. It is a smoothing operation on the basis metal, prior to cutting down with tripoli compound.

Walrus hide or bull neck wheels are used at about 2500 rpm for a 6" wheel. The abrasive is 01½ pumice, to which light machine oil is added in order to hold the wheel.

After silver plating, the surface is color buffed with silver rouge and kerosene on a full disc buff, followed by a light buffing with a Canton flannel or domet cloth wheel.

Immersion Tin

Question: We are contemplating installing a tin deposit process like the one mentioned for a deposit on copper alloys on page 454 of the 1960 edition of METAL FINISHING GUIDEBOOK-DIRECTORY.

What we would like to know is, is this process covered by any patents on which a royalty must be paid, or would we be infringing on a patent if we simply went ahead and installed this bath?

C. A. B.

Answer: The immersion tin process detailed in the METAL FINISHING GUIDEBOOK is the Sullivan & Pavlish formula on which the patent expired May 1956. Therefore, the process is now in the public domain.

Plating on Molybdenum

Question: Could you furnish me with the latest method of producing adherent copper, nickel and gold plate on molybdenum. We have a call for this, and have heard that good results are obtainable, even at high temperature.

J. J. H.

Answer: A recommended procedure by Reid & Ogburn is as follows:

1. Treat anodically in equal parts sulfuric and phosphoric acid, at 50-200 amp./ft.^{2} for 2-3 minutes. Rinse.
2. Immerse for 3 minutes in solution of 15% by volume sulfuric acid, 15% by volume muriatic acid, 70% water, and 8 oz./gal. chromic acid. Rinse.
3. Hold in chromium solution for ½ minute without the current on. Then plate at about 1,000 amp./sq.ft. at 180°F. Rinse.
4. Treat anodically in 85% by volume glacial acetic plus 15% by volume sulfuric acid, at 30-70 amp./ft.^{2} until the chromium surface is covered with a dark brown, uniform film. Rinse.
5. Strike in a solution of 2 lbs./gal. nickel chloride and 1 pint/gal. muriatic acid for 2-4 minutes at 250-300 amp./ft.^{2}.
6. Plate as required.

Determination of Cyanide in Wastes

Question: We are in need of a method of chemical analysis for effluent waste water for the determination of cyanide in parts per million. We must accurately determine 0.50 ppm cyanide, and presence of copper, carbonates, tartrates, and potassium hydroxide must not affect accuracy of the method. We have considered Waller's method (Picric Acid), Rhodanine method (Scott's Standard Methods, p. 661, vol. 1), and Ohio River Valley Water Sanitation Commission Method (Procedures for Analyzing Metal Finishing Wastes) and

LEA

ABRASIVE FINISHING METHODS

ALUMINUM and MAGNESIUM

AND THEIR ALLOYS

CASTINGS · FORMINGS · EXTRUSIONS · SPINNINGS · STAMPINGS

Aluminum and Magnesium and their alloys are soft metals with high coefficients of friction and a tendency to be cut away at the grain boundaries if overheated during an abrading operation. These characteristics limit the choice of finishing procedures to those providing sufficient lubrication and those requiring a minimum of pressure.

The objective, of course, is to use the least number of operations permitted by the hardness and original surface to arrive at the desired commercial finish. Recommendations are of necessity rather general, but it is hoped they will serve as a guide. We shall, of course, be glad to make specific recommendations on request after studying samples of work.

POLISHING...A peripheral speed of 5000 sfm is recommended for polishing Aluminum and Magnesium when glue is used to bond the abrasive to the set-up wheel. From 5000 to 7000 sfm would be satisfactory using GRIPMASTER or PLASTI-GLUE cement for bonding the abrasive to the set-up wheels. In either case, the use of bar LUBAR, Clean Grain LUBAR or LIQUALUBE, a liquid lubricant, is necessary to prevent the wheel from loading which slows down the rate of polishing and causes gouging of the surface. Polishing wheels may also be prepared using liquid abrasive-cement compositions, such as LEABRAMENT or PLASTI-BRADE. LEA COMPOUND is frequently used for polishing Aluminum and Magnesium castings with sewed buffs, canvas, felt or leather polishing wheels which have been sized or pre-coated first with bar AD-LEA-SIVE No. 3

The resultant fast-cutting flexible polishing head is top-dressed with LEAROK or LUBAR to produce a smooth metal surface free of adhering dry particles of metal. Such particles would be produced by dry abrasives without the lubrication referred to above and would result in discoloration upon subsequent treatment, such as anodizing.

INTERMEDIATE FLEXIBLE POLISHING...Small defects, flash, etc. are removed and the surface brought to a uniform finish, using a flexible polishing step with a LEA COMPOUND (such as Grade "N") on sewed buffs or loose muslin sections at 4000 to 5000 sfm.

SATIN FINISHING... This is a final finish produced at surface speeds of 3000 to 5000 feet per minute. Use LEA COMPOUND such as Grades "N", "C" or "B-31" on loose muslin buffs, ventilated or bias buffs, string or wick wheels, with or without LEAROK or LUBAR lubricant, according to the line effect desired.

MATTE FINISHING... This is also a final finish, frosted in appearance. Using Grade "C" LEA COMPOUND at 5000 sfm on ⅜" sewed buff wheels will develop the heat necessary to produce the sand blast or frosted type of finish.

BUTLER FINISHING...To produce this final finish showing no surface defects, we suggest Grade "A-1", "B-12" or "MH" LEA COMPOUND on loose muslin buffs at 3000 to 5000 sfm.

BRIGHT FINISHING (Bar Compositions)... For cutting down stampings or extrusions, use Grade 765 LEAROK, at 6000 to 7500 sfm; for coloring, follow this step with Grade 884 LEAROK at the same speed. Use loose muslin buffs for both operations. For cutting down castings, use Grade 406 LEAROK; for coloring, use Grade 309 LEAROK.

BRIGHT FINISHING (Liquid Compositions)... All operations at 6000 to 8000 sfm.

Castings & Extrusions

Heavy Cut—FH77J or UF47J Liquabrade
Cut & Color—TH52P or 4994 Liquabrade
Color—UH20A or UH20D Liquabrade
Buff—Sisal for Heavy Cut; Ventilated or Sewed for Cut and Color; Loose buff for coloring

Stampings & Extrusions

Cut—TH52P or 4994
Color—UH20A or UH20D Liquabrade
Buffs—Ventilated or Sewed

MAGNESIUM ALLOYS

Finishing methods for magnesium and its alloys closely parallel those for aluminum except that certain magnesium alloys do not drag or tear making unnecessary as much lubrication as is usually required with aluminum. Refer to above for general procedure.

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have found none of these entirely suitable. The procedure must be dependable, accurate, simple and require a minimum of apparatus and reagents.

We would appreciate any help you can provide to meet this problem.

D. H.

Answer: A simple, rapid procedure for determining cyanide in wastes was described by Nusbaum & Skupeko (Metal Finishing, **49**, 61-2. Oct. 1951), stated to be suitable for concentrations between 0.1 and 1.0 ppm. The method is as follows:

To a 10 ml. sample containing up to 0.005 mg. CN^-, add 2 drops of 10% phosphoric acid and a few drops of bromine water until the mixture shows a slight excess of bromine coloration.

Add 2% sodium arsenite solution dropwise until the color disappears, then add one extra drop.

Add 10 ml. n-butyl alcohol, stopper the flask and shake.

Add a mixture of 5 ml. 25% pyridine solution containing 2% HCl, and 0.3 ml. 2% benzidine hydrochloride solution.

Stopper the flask, shake well, and allow the orange color to develop for 15 minutes. Then compare with standards prepared with different amounts of cyanide.

Plating on Solder

Question: We have a problem in making nickel, copper and chrome stick to our soldered products. The plate peels only where the products have been soldered and where the soldering flux runs on the brass tubes.

Following are the steps we use in our plating operation:

1. Solder brass and steel with solder made up of 30% lead and 70% tin.
2. Tumble these parts in proprietary material.
3. Rinse in hot water and dip in a rust preventative.
4. Alkaline clean. Rinse and copper strike.
5. Bright nickel plate.

We would be greatly appreciative of your assistance with this problem.

A. B.

Answer: According to the cycle outlined, no acid dip is used after cleaning. This is a necessary step and should be included in the cycle. A commonly employed dip for this purpose is 10-20% by volume fluoboric acid in a plastic or rubber-lined tank.

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Patents

RECENTLY GRANTED PATENTS IN THE METAL FINISHING FIELD

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Conversion Coating — Aluminum

U. S. Patent 2,948,643. *Aug.* 9, 1960.
G. H. Pimbley, assignor to Turco Products, Inc.

A process for applying a coating to surfaces of objects of aluminum and its alloys, which comprises treating said objects in an aqueous acidic bath consisting essentially of about 0.5 to about 8.0 grams per liter of a cation of the group consisting of zinc, cadmium and mercury, a minor effective amount of a halogen-containing anion, and an anion containing hexavalent chromium in an amount equivalent to between about 0.5 and about 9.0 grams per liter of chromium.

Ultrasonic Degreaser

U. S. Patent 2,949,121. *Aug.* 16, 1960.
T. J. Kearney, assignor to Detrex Chemical Industries, Inc.

Apparatus for degreasing a work object comprising a well being adapted to contain a chlorinated hydrocarbon liquid, transducer means including a pair of spaced apart transducers mounted below the surface of said liquid for emitting ultrasonic waves, and means for carrying the work object through said overlapping zone so that every part of the work object is bombarded by the waves of said overlapping zone.

Recoating Method

U. S. Patent 2,949,380. *Aug.* 16, 1960.
H. J. Stuart, assignor to E. I. du Pont de Nemours & Co.

A process for reoperating alkyd enamels which comprises applying to the baked surface to be reoperated a coat of a composition consisting essentially of solvent, 100 parts by weight of epoxyhydroxy polyether resin having an epoxide equivalent of at least about 1300 and a melting point of at least about 115°C., curing agent for said epoxyhydroxy polyether resin in an amount chemically combinable with about from 5 to 100% of the epoxy groups in said resin and about from 10 to 25 parts by weight of swellable, organic ammonium-modified, aluminum silicate clay, said epoxyhydroxy polyether resin being present in solution in said solvent, applying a coat of alkyd enamel over said coat of epoxyhydroxy polyether resin composition and making the resulting finishing system.

Electroforming

U. S. Patent 2,949,410. *Aug.* 16, 1960.
G. H. Bingham, Jr., assignor to Cambridge Rubber Co.

Process for making a unitary, seamless, hollow mold having walls of minimum thickness consistent with use of the mold in forming a boot by the slush molding process.

Anodizing Titanium

U. S. Patent 2,949,411. *Aug.* 16, 1960.
K. O. Beck, assignor to Titanium Metals Corp. of America.

In a process for anodizing the surface of an article composed of metal selected from the group consisting of titanium and titanium base alloys, the improvement which comprises, employing as an electrolyte in said anodizing process an aqueous solution of pH from about pH 3 to pH 12 consisting essentially of water and at least two cations selected from the group consisting of the alkali metals and ammonium, and a phosphate anion in amount at least 70 grams per liter.

Hot Dipping

U. S. Patent 2,950,215. *Aug.* 23, 1960.
J. C. Slater and E. W. Platt, assignors to Armco Steel Corp.

In the coating of metallic strip with a layer of another metal by passing said strip through a bath of molten coating metal having a pot roll in the bath, the method of improving the quality of said coating which includes the steps of holding said pot roll against rotation to cause the side of the strip contacting the pot roll to be wiped, and wiping the other side of the strip by causing it to pass in frictional contact with a second wiping surface located under the surface of said bath.

Power Brush

U. S. Patent 2,950,495. *Aug.* 30, 1960.
N. H. Stingley, assignor to The Osborn Mfg. Co.

A rotary brushing tool having a central rotatable hub, brush bristle material secured thereto and extending generally radially therefrom, and elastomeric material interposed between said bristles adjacent the working face of the tool and resiliently spacing the bristles apart; wherein said elastomeric material is a resiliently deformable cellular composition.

Paint Baking Oven

U. S. Patent 2,950,098. *Aug.* 23, 1960.
R. J. Ruff, assignor to Catalytic Combustion Corp.

A coating oven for heat treating coated articles to evaporate coating solvents and remove combustibles from the vaporized solvents, said oven comprising an elongated heat treating chamber, having an entrance at one end and an exit at the other.

Chromium Bath

U. S. Patent 2,950,234. *Aug.* 23, 1960.
A. A. Johnson and G. Dubpernell, assignors to Metal & Thermit Corp.

An improved method of electrodepositing chromium on a metal article by means of an aqueous CrO_3-containing, catalyst-containing, chromium plating bath, said method being characterized by having a CrO_3/catalyst ratio in said bath which has a substantially reduced tendency to change with changes in CrO_3 and catalyst concentrations and temperatures, which comprises essentially: passing current from an anode to said article as a cathode immersed in said bath at a temperature of 90 to 140°F.; said bath containing a total of dissolved CrO_3 of about 150 to about 380 g./l., strontium sulfate and potassium silicofluoride as catalyst-supplying compounds each in an amount sufficient to saturate said bath with dissolved catalytic sulfate and silicofluoride, respectively, and to provide therein an undissolved residue of each compound, and potassium dichromate as a non-catalytic, silicofluo-

ride-suppressing, CrO_3- and potassium-supplying compound; said potassium dichromate being present in an amount in excess of its solubility in the bath and providing: (1) an undissolved residue thereof in said bath, (2) a portion of said total dissolved CrO_3 equal to about 30 to about 77 by weight of said total, and (3) an amount of dissolved potassium to suppress the concentration of the dissolved silicofluoride; the concentration of said portion of dissolved CrO_3 being self-regulated owing to the presence of said undissolved residue of potassium dichromate, said suppressed silicofluoride concentration being self-regulated owing to the presence of said undissolved residue of potassium silicofluoride, said dissolved potassium concentration being self-regulated by virtue of the presence of said undissolved residues of potassium silicofluoride and potassium dichromate, and said dissolved sulfate concentration being self-regulated owing to the presence of said undissolved residue of strontium sulfate; 70 to 170 g./l. of said total dissolved CrO_3 being supplied as chromic anhydride; the relationship between said temperature, said chromic anhydride, said total and said portion of dissolved CrO_3 being variable in the manner defined by the area EFGHE of the graph shown in the accompanying drawing; and the ratio of total dissolved CrO_3 to the sum of dissolved sulfate plus ½ the dissolved silicofluoride being in the range of 115:1 to 140:1.

Non-Sludging Acid Copper Bath

U. S. Patent 2,950,235. *Aug.* 23, 1960. *W. Strauss and W-D Willmund, assignors to Dehydag, Deutsche Hydrierwerke G.m.b.H.*

An acid copper electroplating bath for producing copper electrodeposits of high quality free from anode sludge, comprising an aqueous acid solution of a copper salt and a compound selected from the group consisting of compounds having the following general structural formula:

$$Z_n[R—SO_3H]$$

and water soluble salts thereof, wherein R is a radical selected from the group consisting of lower aliphatic saturated hydrocarbon and aromatic hydrocarbon radicals, Z is an azido group and *n* is a whole number of at least one, said compound being added in an amount sufficient to prevent sludge formation.

Nacreous Pigment

U. S. Patent 2,950,981. *Aug.* 30, 1960. *H. A. Miller and L. M. Greenstein, assignors to Francis Earle Laboratories, Inc.*

A nacreous pigment having, as a nacre-producing substance therein, basic lead carbonate in the form of hexagonal crystal platelets of a diameter of from about 3 to 50 microns, a thickness of from about 10 to 50 millimicrons, and having a luster at least as great as that of natural pearl essence and in the range of about 650 to 1000 as determined by a standard dipping test performed in a nitrocellulose-containing dipping lacquer, the surfaces thereof being smooth and substantially free of adhering crystal fragments and uneven overgrowths.

Polishing Machine

U. S. Patent 2,950,493. *Aug.* 30, 1960. *L. Rosolia and P. De Mauro, assignors to Globe Lighting Products, Inc.*

Polishing apparatus, comprising a polishing station, work-polishing means at said station, a plurality of work holders, a carrier for said work holders for moving them in succession to and from said polishing station, and means mounting each of said work holders for movement for bringing the work thereon into and out of engagement with said polishing means and for moving the work thereon relatively to said polishing means in engagement therewith.

Ultrasonic Cleaning Unit

U. S. Patent 2,950,725. *Aug.* 30, 1960. *S. E. Jacke, L. C. Newsome and J. W. Collison, assignors to Detrex Chemical Industries, Inc.*

Ultrasonic cleaning apparatus for cleaning a work object in a well containing a cleaning liquid, said apparatus comprising a hermetically sealed housing submerged in said liquid; a focused emitting plate for emitting ultrasonic waves, said emitting plate forming part of said housing and being spaced away from said work object, and a plurality of flat transducers.

Hot Dip Aluminum Coating

U. S. Patent 2,950,991. *Aug.* 30, 1960. *H. W. Seymour, assignor to American Chain & Cable Co., Inc.*

The improvement which comprises introducing the coated shape immediately upon withdrawal from the aluminum bath and while the aluminum coating thereon is still fluid into direct contact with a dense mist of liquid coolant, said mist comprising a gaseous suspension of very finely divided coolant droplets, the particle size of said droplets being sufficiently small so that settlement thereof from suspension is negligibly slow and the velocity with which said droplets impinge on said shape being sufficiently low so that substantially no deformation of the aluminum coating thereon while it is still fluid is caused thereby and the density of said mist being sufficient to cool an aluminum coated wire 0.1 inch in diameter from 1250°F. to below 900°F. in less than fifteen seconds, whereby said coating is quenched and congealed before flow of the molten coating metal can result in a coating having substantial irregularities in thickness and surface smoothness.

Neptunium Bath

U. S. Patent 2,951,018. *Aug.* 30, 1960. *G. T. Seaborg and A. C. Wahl, assignors to the United States of America.*

The process of electrodepositing neptunium from solutions thereof, which comprises conducting the electrodeposition from an absolute alcohol bath containing a neptunium nitrate and lanthanum nitrate at a potential of approximately fifty volts and a current density of between about 1.8 and 4.7 milliamperes per square decimeter.

Polonium Bath

U. S. Patent 2,951,020. *Aug.* 30, 1960. *R. F. Wehrmann, assignor to the United States of America.*

The method of obtaining a thick, smooth foil of polonium which comprises electrolyzing an aqueous solution of 1 N hydrofluoric acid containing about 0.13 curie of polonium per cubic centimeter of solution, said electrolysis employing platinum electrodes and a current density of about 1.2 milliamperes per square centimeter of cathode surface.

Anodizing Power Supply

U. S. Patent 2,951,025. *Aug.* 30, 1960. *N. Mostovych and A. Cybriwsky, assignors to Reynolds Metals Co.*

An anodizing apparatus comprising: a polyphase alternating current power supply having a power terminal for each phase and a common ground

terminal; a plurality of electrolyte-containing anodizing tanks, one for each phase, each having a cathode terminal and adapted to hold a metal surface to be anodized; connection means adapted to interconnect the metal surfaces to be anodized to said common ground terminal; a plurality of rectifiers, one for each phase, each connected to permit power to flow from a power terminal to the corresponding cathode terminal; and means electrically connecting the cathode terminals of the tanks together to cause said alternating current power supply to energize said tanks with direct current composed of overlapping impulses.

Chromium Plating Process

U. S. Patent 2,951,794. *Aug.* 30, 1960. *R. S. Dean and F. X. McCawley, assignors to Chicago Development Corp.*

The method of producing a non-porous chromium plate on a steel cathode electrochemically protective to said steel which consists in passing a direct current from a comminuted crude chromium anode to said steel cathode in an electrolytic cell having an electrolyte consisting of at least one alkalinous chloride in which is dissolved from 1-10% chromium as chloride having an average valence of 2.05-2.2 and about 0.1% alkalinous metal as determined by hydrogen evolution in acidified ferric chloride solution, at a temperature of about 800°C. and a current density on the original cathode surface of 10-500 amperes/sq. ft. and on the anode from .01-50 amperes per square foot until a plate on the cathode of at least one mil thickness is formed, then continuing the electrolysis to produce a layer of salt containing fine chromium crystals up to 10 mils thick surmounts the plate, then cooling the cathode and adherent deposit in an inert atmosphere and removing the layer of salt and fine crystals by scrubbing with water.

Coating Apparatus

U. S. Patent 2,952,351. *Sept.* 13, 1960. *R. H. Stone, assignor to Ransburg Electro-Coating Corp.*

Article coating apparatus comprising a conveyor, a hanger rotatably supported on said conveyor, a main support rigidly connected to said hanger for supporting a first article on the axis of said hanger, an auxiliary support rigidly connected to said hanger, said auxiliary support including a spindle the axis of which is generally parallel to the axis of the hanger and offset therefrom and a member rotatably mounted on said spindle and adjacent the first article and partially shielded thereby.

Protective Silicate Coating

U. S. Patent 2,952,562. *Sept.* 13, 1960. *L. Morris and F. Lombardo, assignors to Amercoat Corp.*

The method of coating a metal structure which comprises: applying to the surface of said structure a coat of a silicate material selected from the class consisting of zinc silicate, lead silicate, zinc-lead silicate and mixtures thereof, the thickness of said coat not exceeding about 2 mils, air drying said coat, and then applying to said coat a film of a curing agent comprising an alcohol solution of an organic, acidic, amine salt of an acid selected from the group consisting of phosphoric acid, sulfuric acid, hydrochloric acid, nitric acid and chromic acid subject to hydrolysis in the presence of said coat to release an acid radical which will react with said coat to harden and insolubilize said coat.

Hot Galvanizing

U. S. Patent 2,952,568. *Sept.* 13, 1960. *W. L. Diehl and H. S. Bell, assignors to Wheeling Steel Corp.*

Continuous hot dip galvanizing of metal strip in which the strip is delivered upwardly at high speed out of the galvanizing bath of molten spelter between exit rolls partly immersed in the bath engaging the respective faces of the strip and arranged with their axes parallel and generally horizontal.

Gas Plating

U. S. Patent 2,953,472. *Sept.* 20, 1960. *J. S. Nachtman and J. Bjorksten*

The process of coating a metallic article with a metal which comprises the steps of preheating said metal article to a temperature of at least 300°F. and then causing the flame of burning gaseous metal carbonyl in an oxygen containing gas to impinge on the article.

Hot Dip Aluminum Coating

U. S. Patent 2,953,473. *Sept.* 20, 1960. *D. W. Mitchell, assignor to American Mollerizing Corp.*

A process for continuously coating basis metals with a molten coating metal selected from the group consisting of aluminum and alumirum alloys, wherein said molten coating metal overlies at least a portion of a heavier molten salt bath.

Conversion Coating

U. S. Patent 2,953,487. *Sept.* 20, 1960. *G. F. Otto, assignor to Amchem Products, Inc.*

In the coating of corrosion resistant alloys from the class which consists of nickel base alloys and stainless steels, the method which comprises subjecting the surface of the alloy to the action of an aqueous acid solution consisting essentially of oxalate and borate ions and a sulfur bearing compound containing oxygen, which compound is capable of yielding sulfur and sulfur dioxide in the solution; the concentration of oxalate ion in the solution being from 2 to 500 grams/liter, the quantity of borate ion being from 0.1 part to 4.0 parts for each part of oxalate (weight/weight), and the sulfur bearing compound being chosen from the class which consists of thiosulfates, sulfites, thionates and hydrosulfites in an amount such that a 10 ml. sample of the solution will react with at least 2 mls. but with no more than 15 mls. of a 0.05 N iodine solution, using starch indicator to a blue endpoint; the pH of the solution being from 0.5 to 2.5.

Conversion Coating

U. S. Reissue Patent 24,875. *Sept.* 27, 1960. *L. McDonald, assignor to Kelite Corp.*

A corrosion protective composition for metals comprising an aqueous coating bath including a major proportion of a water-soluble inorganic component reactive with said metal to provide a corrosion-resistant coating thereon and a minor proportion of from about 10-20% by weight based on said water-soluble inorganic component of a polymeric material containing a strong polar grouping selected from the group consisting of polystyrene sulfonic acid, polystyrene phosphonic acid, styrene heteropolymer of maleic acid, styrene heteropolymer of ammonium maleate and polystyrene sulfonic acid ammonium salt.

Sandblast Machine

U. S. Patent 2,953,876. *Sept.* 27, 1960. *H. C. Zieber, R. E. Brown and R. L. Wengerd*

An automatic sandblasting machine for use with an enclosure adapted to

receive work to be acted upon by a blast of comminuted abrasive material.

Stripping Electroless Nickel

U. S. Patent 2,954,289. *Sept.* 27, 1960. *B. J. Sherwood and W. R. Hoyt, assignors to Chemplate Corp.*

The method of stripping nickel-phosphorus alloy plating from a steel workpiece without attacking the basis metal, including the step of: immersing the work piece in a stripping bath containing from about 41.5 mole per cent to about 68.4 mole per cent fuming nitric acid, from about 2.9 mole per cent to about 24.5 mole per cent hydrofluoric acid, and the remainder water.

Plating Rack

U. S. Patent 2,953,512. *Sept.* 20, 1960. *G. Villette*

In combination with a plating rack an assembly for supporting an article comprising a sleeve member, a pair of notches formed at the end of said sleeve member, and a pin extending at one end thereof into said sleeve member, said pin having a pair of diametrically opposed wings radiating therefrom and registering with said notches, the pin having a portion of the said end extending into the sleeve member bent to form an angle with the longitudinal axis of the pin, said bent portion having a length about twice the diameter of the pin, the respective ends of said bent portion engaging against respective walls of said sleeve member.

Conversion Coating

U. S. Patent 2,954,309. *Sept.* 27, 1960. *C. M. Swalm and S. Spring, assignors to Pennsalt Chemicals Corp.*

A phosphating composition for iron, zinc and their alloys consisting essentially of a dihydrogen phosphate of the group consisting of sodium, potassium and ammonium dihydrogen phosphate, an acid pyrophosphate of the group consisting of sodium and potassium acid pyrophosphate and a small amount relative to the proportions of said first two ingredients of a soluble compound of a metal ion of the group consisting of pentavalent arsenic, trivalent arsenic and trivalent chromium, the amount of said last mentioned ingredient being effective to improve the corrosion resistance of the phosphate coatings produced by said composition.

Bright Copper Bath

U. S. Patent 2,954,331. *Sept.* 27, 1960. *C. N. Abbott, assignor to Dayton Bright Copper Co.*

Copper sulfate, sulfuric acid, a primary brightener in proportions of 5 to 50 mg./l. of solution, from the group consisting of pyridine, thiourea, allylthiourea and acetylthiourea, and wherein there is additionally incorporated polyacrylamide as a filler and brightener, in the amount of 0.005 to 0.05 g./l.

Chemical Deburring

U. S. Patent 2,955,027. *Oct.* 4, 1960. *I. L. Newell and E. A. Walen*

A method for deburring zinc-base die castings consisting of treating the die castings with an aqueous acid bath containing, in each 1 to 11 liters in solution, 110 to 350 grams of a chromate radical, 32 to 150 grams of a nitrate radical, 28 to 120 grams of a radical taken from the group of weak acid radicals consisting of borates, formates, acetates, propionates and butyrates, 32 to 180 grams of a radical taken from the group of fluorine compounds consisting of fluorides, fluoborates and fluosilicates, 16 to 30 grams of a radical taken from the group of strong mineral acid radicals consisting of sulphates, phosphates and sulfamates, at least 90% of the radicals to come from acids and the remainder water, the treatment time being for a period between 5 seconds and 10 minutes at a bath temperature between 60°F. and 165° F.

Electrostatic Coating Apparatus

U. S. Patent 2,955,565. *Oct.* 11, 1960. *R. M. Schotland, assignor to Electro Dispersion Corp.*

An electrostatic atomizing assembly for the deposition of liquid on an article maintained in a substantially field-free space.

Conversion Coating

U. S. Patent 2,955,061. *Oct.* 4, 1960. *H. A. H. Jenkins, D. B. Freeman and G. R. King, assignors to The Parker Rust Proof Co.*

An aqueous acidic solution for producing a coating on surfaces of zirconium and zirconium base alloys having a pH between 2 and 6 and consisting essentially of the fluoride ion in concentrations between M/8 and 6M, potassium ion in concentration between M/8 and 2M except that up to one-half of the potassium ion is replaced by an equivalent amount of one or more other alkali metals including ammonium ion, and nitrate ion, and the amount of the potassium ion being not less than $\frac{1}{8}$ M.

Automatic Painting Machine

U. S. Patent 2,955,567. *Oct.* 11, 1960. *R. B. Way and C. D. Hersey*

Apparatus for applying coating compounds to articles, said apparatus having an application area and a cleansing area, a mask carrying plate, form fitting a mask means on said plate, a support, said support being rotatable about a horizontal axis, said mask carrying plate being attached to said rotatable support, intermittently acting shifting means to rotate said support with said mask means thereon from said application area to said cleansing area below said application area and from said cleansing area to said application area, applying means for applying coating compounds to articles supported by said plate and within said mask means within said application area, fluid cleansing means for removing surplus coating compounds from said mask means while in said cleansing area, automatic means for causing cyclic operation of said applying means, and means for selectively varying the timing of operation of said shifting means, and means to direct air on said mask means when said mask means is moved from said cleansing area to remove excess cleaning fluid of said fluid cleansing means from said mask means.

Bright Copper Process

U. S. Patent 2,955,992. *Oct.* 11, 1960. *E. Laue, assignor to MacDermid Inc.*

Electroplating copper at a current density of 1 to 75 a.s.f. from a copper cyanide plating solution containing as the only compound which has a brightening effect upon the copper plate within said current density range an inorganic selenium compound in which selenium has a valence of less than +4, in amount equivalent to 0.00008 to 0.0032 gram per liter of selenium, while applying interrupted current, where the plating phases are longer than 1 second and shorter than about 60 seconds and the interruption phases reduce polarization with removal of less than 10% of the deposit of the plating phases.

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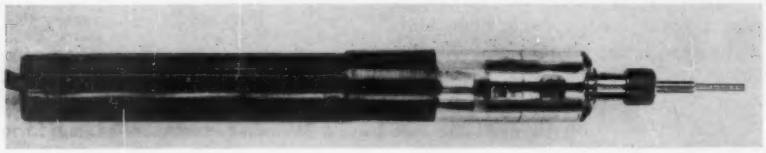
NEW
METHODS, MATERIALS AND EQUIPMENT FOR METAL FINISHING INDUSTRIES

Silicon Diode Tester



Rapid Electric Co., Dept. MF, 2881 Middletown Road, Bronx 61, N. Y.

A new, handy, silicon diode "self-service" tester offers a simple, easy-to-use method to check all types of silicon diodes. The instrument reduces unit down-time should diode failure occur. The Rapid-Probe can also be used as a multi-tester for general circuit tracing.

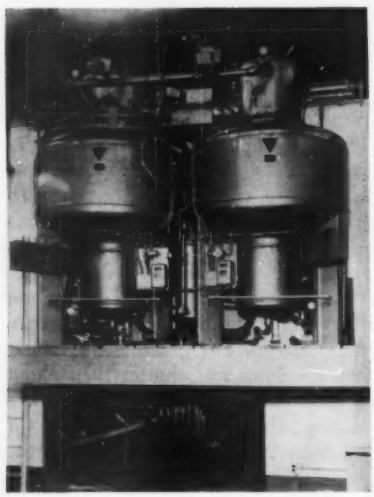
All the manufacturer's silicon units are equipped with this probe at no extra cost.

Solvent Vapor Recovery System

Industrial Div., Vic Mfg. Co., Dept. MF, 1313 Hawthorne Ave., Minneapolis, Minn.

A new vapor recovery system captures solvent vapors evaporating during degreasing and cleaning operations, by ducting them into a specially designed tank with a bed of activated carbon . . . returning clear, reusable solvent after a steaming and decantering process.

The systems are available in 11 different automatic and manual models, designed for compact installation with a minimum loss of valuable manufacturing space. Should a particular installation require specialized engineering or electrical characteristics, the manufacturer states that it is possible to build variations of the standard systems to meet specialized requirements.



Nickel Chloride

Harshaw Chemical Co., Dept. MF, 1945 E. 97th St., Cleveland 6, O.

A new nickel chloride with less water of hydration and demonstrating marked improvements over that which was previously available to platers, "Ni-Chlor 31" has a typical average of 31% nickel compared to 24.5% in ordinary nickel chloride. This means that 0.8 lb. is equivalent to 1 lb. of regular nickel chloride and results in easier handling and storing.

The salt is non-caking, uniform, and of high purity, with quick dissolving characteristics. On the basis of nickel content, it is offered at no increase in cost.

Rust Preventive

Patclin Chemical Co., Inc., Dept. MF, 11-23 St. Casimir Ave., Yonkers, N. Y.

A series of water-displacing rust preventives, for use between operations, is especially applicable in preventing rusting after deburring, barrel cleaning, and burnishing. Three grades are being marketed: #404 leaves a light monomolecular film, #430 leaves a soft non-drying film, #431 leaves a hard waxy film.

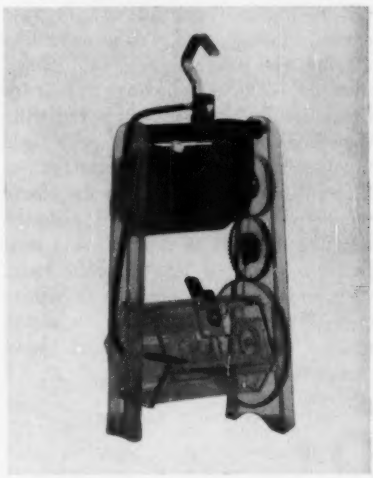
#404 water displacer can be used after plating, to prevent staining and spotting out. In this case the rust preventive film is removed in a vapor degreaser.

The materials are sold in 55 gallon non-returnable drums.

Plating Barrel

Hardwood Line Mfg. Co., Dept. MF, 2022 N. California Ave., Chicago 47, Ill.

Model 2BM, an improved, all plastic portable barrel, is the latest in



Lazo equipment. It is more corrosion resistant, has more rigid precision gear alignment and fewer parts throughout the complete barrel, according to the manufacturer.

Available in "handful" lots for production or experiments, the barrel weighs only 6½ lbs., with overall dimensions of 9" x 7" x 17" high; 110 volt, 60 cycles, single phase, gearhead motor.

Plating Resist for Printed Circuits

Meaker Co., Dept. MF, Nutley 10, N. J.

A new photo resist, called Resist-Etch, is said to positively block off unwanted electroplate and to permit accurately defined electroplated pat-

terns in printed circuits calling for lines 0.005" wide, spaced 0.005" apart, even when used by relatively unskilled personnel.

Other features said to be proven in actual usage are: freedom from pinholes; unaffected by all plating cycles, yet easily removed by its companion product Resistrip; will not contaminate base or precious metal plating solutions; and freedom from toxicity.

Lead Anodes

Republic Lead Equip. Co., Dept. MF, 7930 Jones Road, Cleveland 5, Ohio.

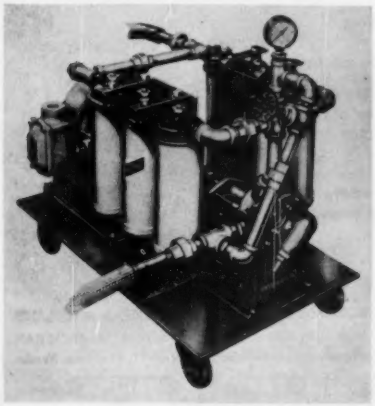
The above manufacturer's lead anodes can now be furnished with new extruded aluminum hooks, which will not corrode and pit. Positive electrical contact between bus bar and hook is maintained undiminished throughout the anode's service life.

The hook is homogeneously bonded to the anode using an exclusive nonmetallic flux and specialized techniques. The special type aluminum used, gives the hooks an electrical conductivity of 53%, slightly above that of the extensively-used cast copper hooks, which have a conductivity of 45% to 50%, depending upon impurities. They are available in both flat and knife edge types and can be furnished with hollow round, solid round, rectangular ribbed and flat types and conforming anodes.

Filter for Vacuum Metalizing Lacquers

Sethco Mfg. Corp., Dept. MF, 2284 Babylon Turnpike, Merrick, N. Y.

The new CCGIE series combines a self-priming gear pump, an approved explosion-proof motor, steel filter chamber with cotton filter tubes, pressure gage, and solvent resistant hose, all mounted on a corrosion resistant mounted on a corrosion resistant panel equipped with ball bearing casters for portability.



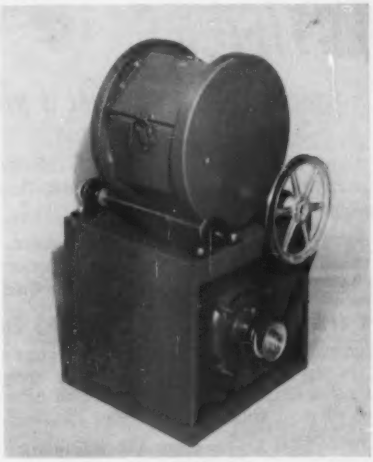
Model CCGIE-2-180

Filter tubes of cotton wound around perforated steel or stainless steel core are available in different mesh sizes to filter out particles from 150 down to 1 micron in size. Each filter tube will remove approximately one pound of dirt before the need for replacement or back-flushing arises.

Available in capacities from 30 to 1200 gallons per hour for lacquer, these filter systems are also suitable for filtering paints, solvents, oils, and emulsion cleaners.

Barrel Finisher

Delta Mfg. Co., Dept. MF, 1137 W. Hilton, Phoenix, Ariz.



The "500" tumbler, illustrated, is said to save 70% on labor. The quick change barrel speeds, from 25-45 r.p.m., make the unit adaptable for most tumbling, grinding or polishing needs. Capacity is 1¾ gallons.

Also available is the model "200" tumbler, a dual barrel finisher for deburring, polishing, burnishing, roughing or deflashing.

Barrel Finishing Compounds

Almco-Queen Products Div., King-Seeley Corp., Dept. MF, Albert Lea, Minn.

Compound No. 101 is a highly concentrated powder specifically formulated to burnish aluminum, zinc, stainless steel and other metals to a highly uniform, lustrous finish. It has proven to be a universal burnishing compound for die-cast parts, in many cases giv-

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2. **MORE RECTIFICATION AREA**—twice the number of cells found in ordinary rectifiers, with each cell having over 2½ times the usual rectification area. This gives you a more uniform power supply . . . fewer operating troubles with maximum efficiency!
3. **UNIQUE COOLING SYSTEM**—a special-type blower and strategically located baffles force pressurized air directly across the cells, assuring longer cell life and highest possible cell efficiency.
4. **OVERLOAD PROTECTION**—our exclusive built-in protective devices shut down the rectifier before highly unusual overload or other dangerous situation causes damage to the cells.
5. **RUGGED COMPONENTS**—Wagner-built transformers have Class B insulation (inorganic materials) . . . exposed bus bars are silver plated . . . housings are ruggedly built . . . meters are shielded to protect their precision accuracy.

Wagner Silicon Rectifiers are available in capacities ranging from 500 to 50,000 amperes with full selection of controls for manual or automatic regulation. Wagner Selenium Rectifiers also available in the same range of capacities.

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IRIDITE® Chromates | IRILAC® Coatings | ISOBRITE® Brighteners | ARP® Supplies | WAGNER Equipment

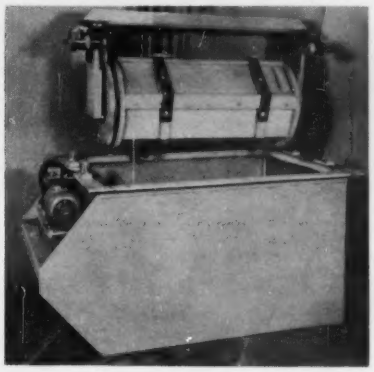
ing results that equal or surpass hand-buffed finishes, it is claimed.

Compound No. 101A is a cleaning and burnishing liquid for metal cleaning, burnishing, and light degreasing operations. Highly recommended for use in spindle machines, submerged barrels, and the new vibratory, finishing machines, it can also be used in metal stamping, cold rolling, chain and belt lubricants. It is a highly concentrated light amber liquid that does a good job in spindle and vibratory equipment even when diluted as highly as 75 to 1.

Compound No. 403 is a long-lasting, neutral, abrasive compound which can be used with any type of media for cut-down of both ferrous and non-ferrous metals. An economical, closely-screened, aluminum-oxide base compound, it contains grease and oil emulsifiers, water softeners, rust inhibitors, and abrasive materials. It can be used in self tumbling as well as with all types of barrel finishing media to generate radii, improve micro-inch finishes and deburr.

Plastic Plating Barrel

Nu-Lite Plating Equipment Co., Inc., Dept. MF, 777 Meeker Ave., Brooklyn 22, N. Y.



A new plating barrel designed to meet the present and future challenges of plating problems is now available, after two years of testing. It is constructed of a virtually indestructible plastic, formulated into a one-piece welded unit which, according to the manufacturer, can be used safely in any plating solution and at any plating temperature.

The tank linings, gears, hangers and cylinders are also made of the same plastic. The barrel has improved replacement standard gear parts, air

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Includes information on WAGNER Silicon and Selenium Rectifiers, WAGNER Auto-Loaders for transfer of racks and parts from conveyors to plating machines or between conveyors, Automatic and Semi-Automatic Plating Machines, Barrels, Tanks and other equipment.

Also includes information on Process Engineering Service—complete plant design, specification and installation.

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Price and delivery information on a wide variety of plating room necessities, including ROLL-TOP Zinc anodes, FLAT-TOP copper anodes, ELECTROCOP Flat Copper anodes, Cadmium and Tin Anodes, Acid Replacements, Buffs, Chemicals, Cleaners and Maintenance Materials.

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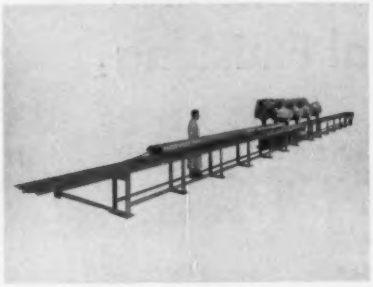
Chemical and Electrochemical Processes, Anodes, Rectifiers, Equipment and Supplies for Metal Finishing

IRIDITE® Chromates | IRILAC® Coatings | ISOBRITE® Brighteners | ARP® Supplies | WAGNER Equipment

cooled motors and new style clamps. The contact assembly will plate any type or shape of component parts, without damage to parts or contact assembly, it is claimed.

Straight Line Buffing Machine

Acme Mfg. Co., Dept. MF, 1400 East Nine Mile Road, Detroit 20, Mich.



A completely new automatic reciprocating type straight line buffing machine for finishing surfaces of long extrusions consists of a conveyor on which a reciprocating work holding platen is mounted and a series of fully adjustable buffing lathes. The reciprocating platen is actuated by a motor driven worm gear and rack and pinion arrangement. The platen has an adjustable stroke mechanism actuated by a reversing controller and two limit switches.

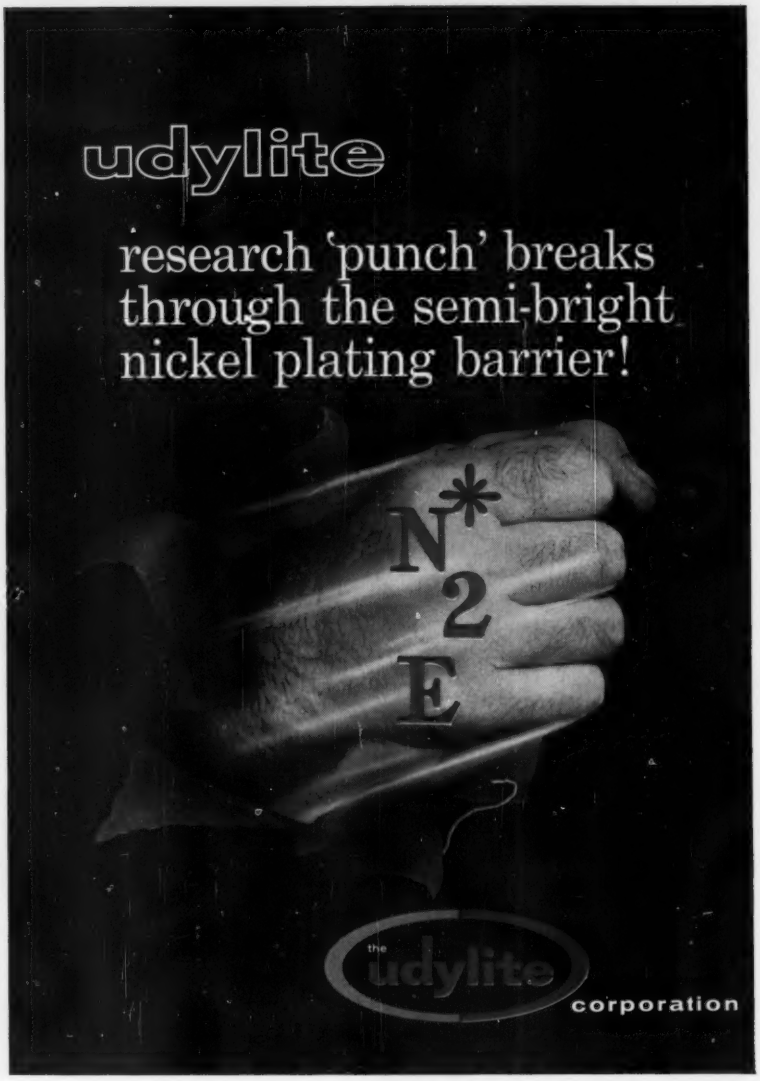
Generally the length of the conveyor is twice the length of the work holding platen plus required lathe space. By utilizing a special drive arrangement this length can be reduced approximately 20 per cent to reduce floor space.

Platen speed can be varied with a 3 to 1 variable speed drive having a normal range of 15 to 45 feet per minute.

The adjustable lathes used on the machine can be equipped with the standard air lift arrangements and interchangeable motorized drive units for automatic buffing wheel wear compensation to maintain correct buffing pressures. Buffing wheel pressures are controlled through a push button control. Electrical controls for the machine are enclosed in a separate control panel.

In a typical extrusion buffing application the extrusions are manually loaded and clamped on the platen of the machine. At the start of the cycle the buffing wheels automatically drop into position and the extrusions are transferred under the buffing heads. As the extrusions approach the first buffing head a limit switch is tripped which starts an automatic buffing compound applicator. A timer control permits intermediate spray or bar application of the buffing compound at preset times or in a continuous operation. After the extrusions have passed the last buffing head a limit switch is tripped which reverses the direction of the platen.

On the return stroke of the platen the buffing wheels rotate in the same direction as the movement of the extrusions and perform a coloring operation. At the end of the return stroke the platen automatically stops and the extrusions are turned for additional buffing operations until all sides of the extrusions are finished.



Alkaline Rust Remover

Turco Products, Inc., Dept. MF, 24600 S. Main St., Wilmington, Cal.

A non-acid, non-flammable rust remover that removes rust, carbon, scale, and paint from ferrous metals without the dangers of hydrogen embrittlement or dimensional tolerance loss, Alkaline Rust Remover removes heavy rust and stubborn paint deposits such as red oxide primer, baked lacquer, acid-proof paint, and asphalt finishes, by means of a simple one-tank operation followed by a pressure rinse. It contains no cyanide compounds and emits no corrosive fumes.

Used in a soak tank or electrolytically, the rust remover requires only

✳ BRAND NEW PROCESS is easier to operate and control, provides better uniformity of color and greater production efficiency than ever before!

here's why:

NO HARMFUL BREAKDOWN PRODUCTS. There are no harmful materials formed from the N2E addition agents as a result of the plating process! Thus, batch treatment is necessary only when contaminants from other sources enter the bath and continuous carbon filtration will not remove them. The result is a substantial saving in solution, downtime, manhours and additional chemicals ordinarily required to treat and rebuild the plating bath.

CONSISTENT UNIFORMITY. N2E addition agents are noncritical in concentration. Reasonable variations from recommended concentrations will not seriously affect the characteristics of the deposit. Overall uniformity of color is maintained. Even in deep recesses on the backs of intricate die castings, amazingly clean deposits are obtained.

WIDE CURRENT DENSITY RANGE. N2E's average current density range is 30 to 60 amperes per square foot, with a considerably higher limiting current density. This wide range permits faster plating at a higher average current density without burning.

GREATER TOLERANCE TO METALLIC IMPURITIES. The absence of harmful breakdown products is of special importance in connection with metallic contaminants, since the undesirable effects of the two are cumulative. Another N2E 'plus' factor that helps maintain uniformity and quality.

ADHESION GREATLY IMPROVED. Production experience over a considerable period of time has conclusively demonstrated the excellent adhesion characteristics of Udylite N2E in combination with the Incomparable '66' Bright Nickel Process.

ECONOMICAL CONTINUOUS FILTRATION. One of the outstanding advantages of N2E is the fact that the bath can be continuously filtered through an activated carbon pack without appreciable loss of brighteners. The cleaning action of the continuous carbon filtration permits long periods of uniform, high quality production. The stability of N2E addition agents also permits economical bath purification by low current density electrolysis.

CAN BE ADDED DIRECTLY TO BATH. N2E addition agents are liquid and can be added directly to the bath without the use of filters. For high-speed operation, air agitation of the bath is recommended, although N2E performs well with mechanical agitation and can even be used without agitation.

See for yourself what N2E can do to improve your plating operation. Submit one of your problem parts for test plating now. See your Udylite representative. Or, write or phone:

detroit 11, michigan • on the west coast: L. H. Butcher Co.

world's largest plating supplier

udylite

a mild steel hot tank of welded construction with stainless steel heating coils. Because of its characteristics, it minimizes the tendencies of the darkening of steel during processing and re-rusting of the metal after processing. Metals withdrawn from the process require no after-neutralization, it is claimed.

Dual Contact Sheet Polisher

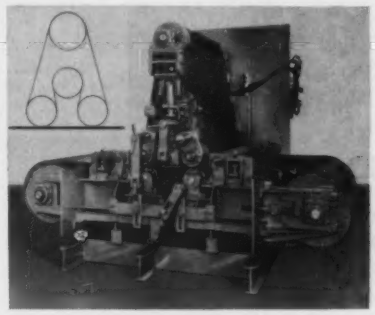
Murray-Way Corp., Dept. MF, P.O. Box 180, Birmingham, Mich.

An economical sheet polishing machine utilizes a unique new concept in abrasive belt polishing. A single, endless, abrasive belt makes contact with the work twice in one pass, providing double the surface finishing ability of standard, single-contact flat polishing machines.

The machine, shown with hood removed, utilizes a 60" wide, single motor-driven abrasive belt which may be operated dry or with a mist spray or belt greasing to produce decorative finishes. Other belt widths may be specified. The dual contact rolls are oil resistant, statically and dynamically balanced, and rubber-covered to any desired density.

The endless conveyor belt is of vulcanized, 6 ply, high-friction, oil-resistant neoprene, running over extra large non-slip conveyor drums. Backlash is eliminated by a special gear coupling, and a compact, "in line" reducer permits selective drive speeds from 20 to 60 f.p.m.

The upper idler roll moves vertically under pneumatic pressure for automatic abrasive belt tensioning and rides in self-aligning precision ball bearings with taper locks. Oscillation of the idler roll is controlled by an automatic, maintenance-free air eye.



Contact roll spindles are outboard arm supported and are hinged for easy removal and replacement of abrasive belts. Spindles and billy rolls are worm-and-gear adjustable, and controls and adjustments are located within comfortable reach of the operator.

Cleaner-Phosphater

Magnus Chemical Co., Dept. MF, Garwood, N. J.

Bondtite (82-X3), a new compound for use in spray washing machines, eliminates pH control problems, keeps spray nozzles clean and combines in one action the cleaning and positive phosphating stages that once required two individual operations, it is stated.

The bath maintains a constant pH of about 5 in any practical concentration strength. This, in effect, ends the necessity for extensive pH testing and addition of compensating materials. The prime concern becomes the solution strength, and this is determined by a simple 60-second test.

Ferrous and non-ferrous metals are thoroughly cleaned of light soils with non-foaming, fast action. Simultaneously, the product provides a uniform, optimum phosphate coating for positive paint adhesion and coverage. It removes shop dirt, soluble and slightly sulfurized oils, light oils and acid-soluble soils. It also neutralizes alkaline residues from previous operations. The material creates no sludge problems. The material is used at concentrations of 1 to 4 ounces per gallon of water at 140-180°F. in spray washing equipment. Normal exposures vary

When You Buy Silver Anodes . .

PAY FOR THE METAL
DON'T PAY FOR SPECIAL SHAPES

With Handy & Harman rolled anodes, you buy exactly what you need in length, width and thickness . . . your initial cost is lower and you've got less cash tied up in inventory.

Another Handy & Harman "added anode attraction" is the range of available finenesses. If you don't need extra fineness, you can specify exactly what you want, and get it. As always, standard requirements are fully met with Handy & Harman's 999 + FINE. And, you can specify any fineness above that grade for your particular needs.

We'd like very much to review with you your anode costs and show you how—with Handy & Harman rolled anodes—you buy the *metal* you need, *not* the shape.

When all is said and done

Handy & Harman's Refining Division is very much interested in your left-overs. Your silver plating solutions, sweeps, scrap and waste get the most *rewarding* attention when you send them to us. Accuracy with what is yours is the basis on which this service is offered. Address your next shipment to the nearest refining station listed below and profit thereby.

HANDY & HARMAN
General Offices: 82 Fulton St., New York 38, N. Y.
BRIDGEPORT, CONN. • PROVIDENCE, R. I. • CHICAGO, ILL. • LOS ANGELES, CALIF. • TORONTO, CANADA

Ship Refinings to the nearest of these plants

EAST COAST			WEST COAST	CENTRAL U. S.
82 Fulton St. New York 38, N. Y.	Bridgeport 1, Conn.	425 Richmond St. Providence 3, R. I.	330 N. Gibson Rd. El Monte (Los Angeles), Calif.	1900 W. Kinzie St. Chicago 22, Ill.

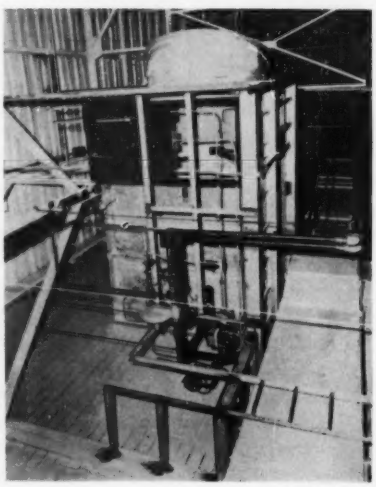
from 1 to 5 minutes. Water rinse to sewer and hot-air drying follow the cleaning operations. The compound can be safely used in plain steel spray washers and tanks.

Packaged Air Make-up Units

J. O. Ross Engineering Div., Midland-Ross Corp., Dept. MF, 730 Third Ave., New York 16, N. Y.

A line of seven "packaged" air make-up units, for use wherever outside air must be brought inside the plant to replace air exhausted in processing operations, is available for supplying 20, 30, 40, 50, 60, 70, and 80,000 cfm.

Each unit comprises a galvanized sheet metal enclosure, approximately

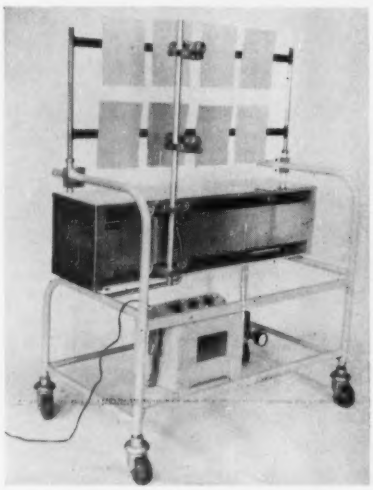


7′ high x 7′ wide x 8′ long. One end of the unit fits an outside wall opening and is equipped with intake louvers, bird screens, and shut-down dampers. The other end is equipped with a fan which draws the air from out-of-doors and directs it into the plant.

A rectangular gas burner inside the enclosure heats incoming winter air to 80°F. prior to distribution into the plant. The enclosure has 3″ thick insulation all around to eliminate wintertime condensation. The gas burner operates on natural or manufactured gas, and the fuel system is automatically regulated to heat incoming outdoor air to the desired temperature. A complete set of gas safety controls is supplied with each unit. Standard air make-up units are also available for steam heating.

Automatic Test Panel Sprayer

Spraymation, Inc., Dept. MF, 25 Amity St., Little Falls, N. J.



Model C9123 automatic panel spraying machine was developed for the production spraying of large quantities of test panels of various sizes. The unit, which is mounted on casters so that it can be easily placed inside a laboratory spray booth, reciprocates spray guns back and forth in front of test panels. At pre-determined intervals, the gun sprays and allows flash-off periods, automatically stopping at the end of the cycle.

The use of this unit permits volume production of panels to a specific cycle for color matching of acrylics.

Completely explosion proof, it carries out the pre-determined cycle without attention from the operator.

Roller Coater

L. R. Wallace & Co., Dept. MF, 172 N. Vernon Ave., Pasadena, Calif.

A new line of glue spreaders and roller coaters includes Series 60 with 4″ rolls, Series 61 with 5″ rolls, and Series 58 with 6″ rolls. All machines are available in single top coater, two

models of double coaters and a single bottom coater, in lengths from 8″ to 72″.

Zinc Brightener

Metal & Thermit Corp., Dept. MF, Rahway, N. J.

Identified as Zinc Brightener 25, this new formulation is a free-flowing liquid that may be added directly to plating baths without prior dilution. It is stated to be extremely useful for applying a uniformly bright zinc plate to low-current-density areas, such as recesses and threads. It is suitable for use in barrel, as well as hand, hoist or automatic plating operations.

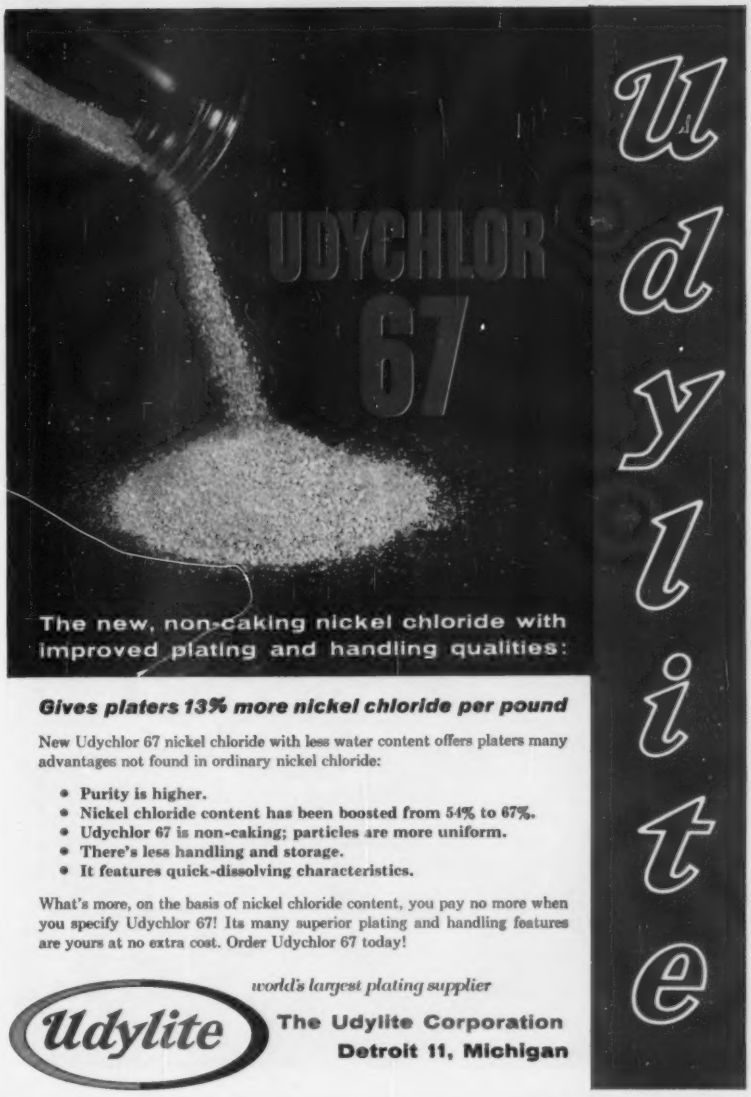
Other claimed advantages for the new liquid brightener include: brilliant and crystal clear zinc deposits that exhibit uniform high luster, exceptional receptivity of the zinc deposits for bright dips and chromate dips; full, bright deposits on case-hardened or hot-rolled steels; packaged in easy-to-handle and easy-to-store, 5-gal. cubitainers.

Porous Metal Filter Element

Commercial Filters Corp., Dept. MF, 2 Main St., Melrose 76, Mass.

A new sintered 316 stainless steel filter element is adaptable to any of the manufacturer's Fulflo filters. The porous metal element is designed for the filtration of fluids with characteristics incompatible with ordinary filter media, particularly corrosive, high temperature and high viscosity fluids.

The metal element is available in uniform 40, 20, 10, 5 and 2 micron particle-retention ratings.


UDYCHLOR 67
The new, non-caking nickel chloride with improved plating and handling qualities:
Gives platers 13% more nickel chloride per pound
New Udychlor 67 nickel chloride with less water content offers platers many advantages not found in ordinary nickel chloride:
• Purity is higher.
• Nickel chloride content has been boosted from 54% to 67%.
• Udychlor 67 is non-caking; particles are more uniform.
• There's less handling and storage.
• It features quick-dissolving characteristics.
What's more, on the basis of nickel chloride content, you pay no more when you specify Udychlor 67! Its many superior plating and handling features are yours at no extra cost. Order Udychlor 67 today!
world's largest plating supplier
Udylite
The Udylite Corporation
Detroit 11, Michigan
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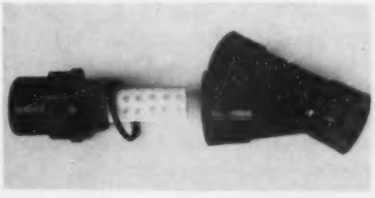
Polypropylene Pipe-line Strainers

Vanton Pump & Equip. Corp., Dept. MF, Hillside, N. J.

These polypropylene strainers are designed to trap particles which would be injurious to the internal moving parts of process equipment. The light weight, high strength and chemical resistant properties of these strainers makes them ideal for applications involving solvents, greases, oils, and the majority of common acids at temperatures up to 185°F. The strainer element can be easily removed for cleaning or replacement. Because they are light in weight these strainers can be installed directly upon the most delicate equipment as well as the process line.



The strainers are available in sizes ½″ thru 2″ with molded thread or socket weld ends.

Airless Spray Gun

Nordson Corp., Dept. MF, Amherst, Ohio.

An entirely new spray gun for use with airless spray coating systems, the "Versa-Gun" features an internal de-

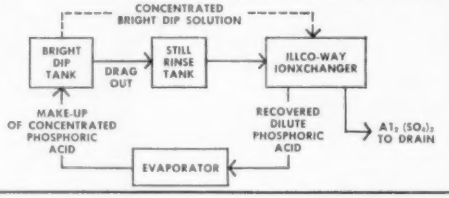
Don't throw it away! RECOVER YOUR ALUMINUM BRIGHT DIP SOLUTION

ILLCO-WAY ionXchange

SPECIALIZED EXPERIENCE SHOWS HOW TO SAVE MONEY

The use of ion-exchange eliminates the need for dumping expensive phosphoric acid. Four years of successful experience in recovery of bright dip solutions enables us to make several recommendations, depending on particular conditions. Usually, we employ a cation exchanger to purify the first rinse, recovering phosphoric acid which has been carried over from the bath by dragout. Another treatment removes aluminum direct from the bath. The use of IWT ionXchange can not only improve the uniformity of your product through better quality control in the plating, but also can be a very *profitable* investment.

PROCESS CAN BE USED IN SEVERAL WAYS



The block diagram at the left illustrates the general methods of treatment suggested above. Actually, every installation presents its own special problems — which IWT engineers are well-equipped to solve. *So, consult your IWT representative for specific suggestions.*

ILLINOIS WATER TREATMENT COMPANY

840 CEDAR STREET
ROCKFORD, ILLINOIS

NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

sign that increases turbulence ahead of the nozzle. This means pressures needed for correct atomization can be lowered sharply.

The spray pattern produced by the gun is accurately controlled, has correctly feathered edges for the proper overlap of gun passes. The increased internal turbulence provides more even atomization and that means this gun has no tendency to "tail." The gun circulates coating materials right up to its nozzle, and this feature, plus fast triggering, prevents "spitting."

The gun is smaller and lighter than any other gun on the market, it is claimed. These advantages, combined with excellent balance, relieve operator fatigue. It may be used with any type airless system: heated or unheated. It comes in circulating or "dead-end models." The gun features carbide nozzles.

Barrel Finisher

Almco Precision Finishing, Queen Products Div., King-Seeley Corp., Dept. MF, Albert Lea, Minn.

Model DB-1616, called the Space Saver, takes up only 4.8 sq. ft. of floor space. Design simplicity contributes to its low price and the unit has a clean, modern and functional appearance. The total capacity of the two-compartment barrel is two cubic feet, each octagonal container measuring 16″ x 8″. A single compartment barrel measuring 16″ in length and diameter is available as optional equipment. Barrels are lined with ¼ inch abrasive-resistant plastisol.

The barrel is rotated by a ½ hp, 220/440 volt, 3 phase, 60 cycle motor, manually operated by switch with overload protectors. The speed is variable from 13 to 39 r.p.m. The overall size of the Space Saver is 28″ long, 25″ wide and 50″ high.

Wall Mounted Chlorinator

Fischer & Porter Co., Dept. MF, 670 Jacksonville Road, Warminster, Pa.

The feature of the 3600 Series wall-mounted chlorinator is the safety stack regulator within which all control components are housed. This simplified design concept reduces frail piping and connections which are potential sources of leaks. Other features of the safety stack design are: a shut-off valve, sealing the chlorine supply from the chlorinator during inoperative periods; an isolating valve, which seals tight the functional parts of the safety stack and prevents even traces of water from entering the chlorinator due to ejector back pressure; and a differential pressure regulator to maintain stable drift-free chlorine gas feed despite wide

variations in chlorine gas pressure, water pressure, or pressure at the point of application.

This manually-operated chlorinator

can maintain an accuracy of ±2% of feed rate over a 20 to 1 range in flow. A simple snap-in flowmeter tube allows capacity changes from 3 to 200 pounds of chlorine gas per day, without the use of tools.

For complete protection against corrosion, the chlorinator is housed in a rigid fiberglass cabinet. A two-tone beige color is an integral part of the cabinet, completely eliminating painting or other maintenance. The total weight is 65 pounds.

Safety Solvent

Kelite Corporation, Dept. MF, 81 Industrial Road, Berkeley Heights, N. J.

Spray White E is water dilutable, and is safe on all common metals and durable painted surfaces. It will not dull paint gloss. Furthermore, the product is safe and non-toxic to personnel under normal conditions of use, it is claimed.

The product is free of caustic chemicals and chlorinated hydrocarbons and is non-flammable. It is strongly buffered to maintain a low pH over a wide range of dilutions. It is effective on both oil wetted and water wetted soils.

This is a versatile product and can be used in a wipe-on or spray-on, wipe-off; soak immersion; or steam cleaning method.

Treated Buff

American Buff Co., Dept. MF, 2414 S. La Salle St., Chicago 16, Ill.

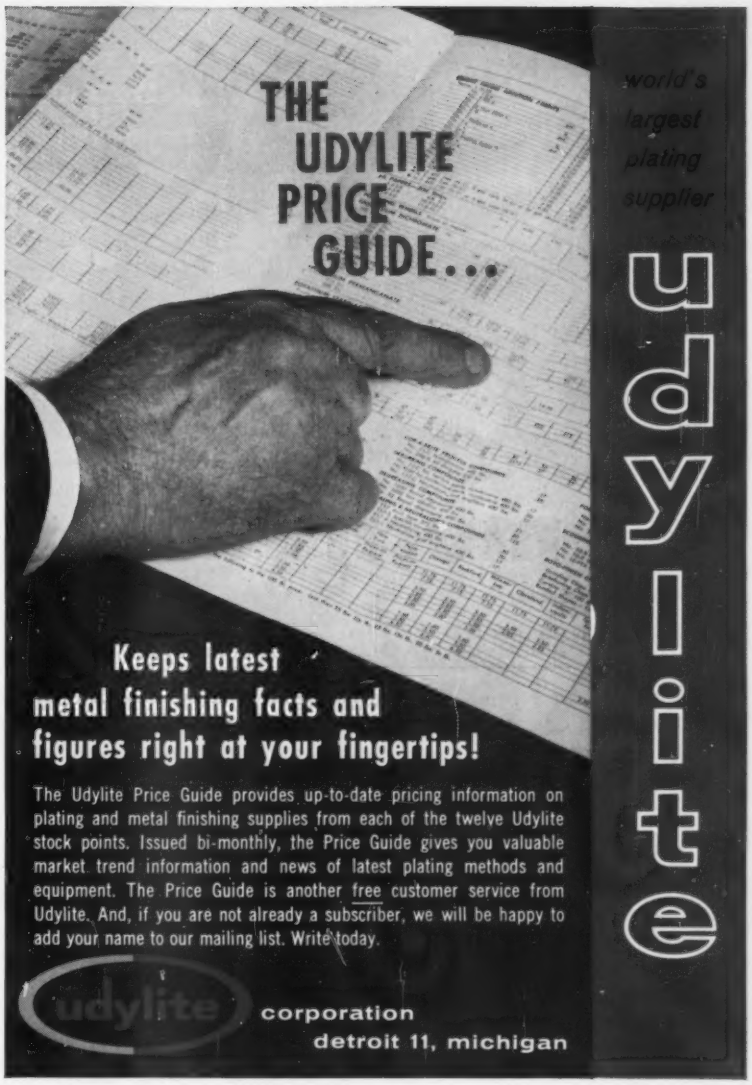
The "Golden Tacky" buff treatment is claimed to strengthen and condition the buff, resulting in faster cutting, streakless, smoother finishing and increased compound-holding characteristics.

The new treatment binds together the fibers of cotton or sisal buffs. It provides firmer body and eliminates loose, frayed fiber ends. Longer wearing and harder cutting, treated buffs retain normal flexibility.

Airless Spray Equipment

Hi-Spray Div., Balcrank, Inc., Dept. MF, 10 Disney St., Cincinnati 9, Ohio.

"Hi-Spray," a new line of airless spray equipment, is claimed to offer better paint coverage at lower cost. The new series of pumps is available in 10 different models, portable and stationary, for handling all types of paints, including water base. The unique feature of the portable models is a self-contained locking device


THE UDYLITE PRICE GUIDE...
world's largest plating supplier
udylite
Keeps latest metal finishing facts and figures right at your fingertips!
The Udylite Price Guide provides up-to-date pricing information on plating and metal finishing supplies from each of the twelve Udylite stock points. Issued bi-monthly, the Price Guide gives you valuable market trend information and news of latest plating methods and equipment. The Price Guide is another free customer service from Udylite. And, if you are not already a subscriber, we will be happy to add your name to our mailing list. Write today.
udylite
corporation
detroit 11, michigan

Load to SPIN-spray

much faster

with new

"Ride-the-Rod" Coating Machine

Big Savings are being made with this new machine, especially on multiple-coat operations where the parts must be rotated.

Each part to be coated is loaded to a work-holder on a spindle—but the spindles are **on Carrier Rods, independent of the chain.**

Placing one Carrier Rod on the machine

LOADS 20 OR 30 PARTS AT ONCE

Lifting off the Carrier Rod unloads all the parts, and they stay on the rod through all stages of painting and baking— single or multiple coats.

Rejects are far less: No finger marks on parts wet with coating, because parts are not handled.

Ideal equipment for the vacuum metallizer to apply base coat, bake and metallize, top coat and bake . . . and metal painting when you prime, bake, finish coat and bake. All done with parts left on the rods.

ROTATING SPINDLES or non-rotating work-holders are used with the "Ride-the-Rod" machine, as required for uniform coverage.

You save machine time when changing from one coating job to another— there's no down time with the "Ride-the-Rod" machine. The operator puts new work-holders on the Carrier Rods in advance— all ready for the change.

For long runs parts can be loaded on the Carrier Rods automatically, and coated at up to 30,000 per hour.

Machine speed is adjustable from 200 to 600 Carrier Rods per hour.

Part rotation speed is also adjustable to suit the job, independently of Carrier Rod travel speed.

For limited production the "Ride-the-Rod" machine can be used like an ordinary chain machine, with the Carrier Rods left on.

Furnished with either dry type or water-wash spray booth. For further details, write or phone FINISH ENGINEERING CO., INC., 921 Greengarden Road, Erie, Pa., Phone GL 5-4478.

FINISH ENGINEERING CO., INC.

which immobilizes both wheel roll and caster swing. This enables the equipment to be used on inclined as well as flat surfaces. Visible pump oil supply is standard on all models.

The double action pump and exceptionally high fluid pressure at the nozzle (1,650 pounds from 75 p.s.i. air pressure) makes possible the use of two guns from each pump. Each gun may be operated up to 75 feet from the pump.

Soap-Free Burnishing Compound

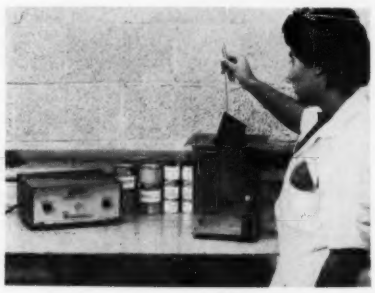
Frederick Gumm Chem. Co., Inc., Dept. MF, 538 Forest St., Kearny, N. J.

Clepo 150-NP, a new liquid burnishing compound, contains no soap and consequently produces surfaces with high luster, even in plants where hard water is used. In addition, burnished metal surfaces are more readily electroplated without the usual hazards of soap-film interference, it is claimed.

The compound is used for ball burnishing aluminum die castings but does not require a pre-etch treatment in strong acids or alkalies to obtain a brilliant, silvery finish. It produces bright surfaces on brass, phosphor-bronze and beryllium copper alloys during self-tumbling without the problem of caking in recessed areas and blind holes that is normally experienced with powdered burnishing compounds.

Ultrasonic Cleaning Unit

Branson Instruments, Inc., Dept. MF, 40 Brown House Road, Stamford, Conn.



A compact ultrasonic cleaning system for production cleaning of small parts and sub-assemblies, Model LG-75 is powered by a 75-watt Sonogen generator driving a transducerized tank at a nominal frequency of 25 kc.

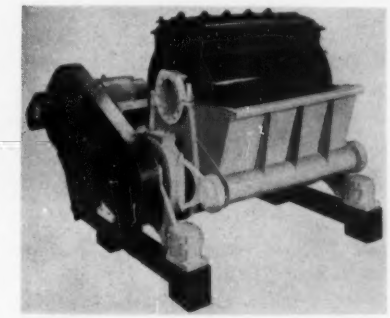
Transistors replace bulky vacuum tubes to achieve a compact generator having long life and requiring little maintenance. The generator cabinet measures 12 x 10 x 5½ in. high. To

operate the unit at peak efficiency, only two simple controls are needed.

Two transducerized tanks, with capacities of 1 or 2 gallons, are available with the system. Tanks are Heliarc-welded of Type 316L stainless steel. Both have optional thermostatically-controlled heating elements for temperatures up to 200°F.

Vibrator Finishers Offered With Interchangeable Drums

Productive Equipment Corp., Dept. MF, 2926 W. Lake St., Chicago 12. Ill.



Selectro Vibro-Finisher's drums are easily interchangeable and are available in many varied sizes, including multiple sectional drums for different types of material requiring different media and finishing time in the same operation. The vibrating mechanism is positive eccentric with adjustable stroke instead of the unbalanced pulley (offset weight) method. This greatly reduces the power needed for operation.

Black Dye for Anodized Aluminum

Technical Process Div., Colonial Alloys Co., Dept. MF, Philadelphia 29, Pa.

Blak Black, is claimed to attain a deep, hard, clean, jet black, free of a smutted surface, in as little as 15 minutes of anodizing (180 ampere minutes), used as directed in many standard color anodizing techniques. Different aluminum alloy compositions may require slight variations in the anodizing time.

The penetration into the anodized coat is fast and uniform, and its finished appearance is a deep jet black. Best results and elimination of all or nearly all of the typical haze following dyeing is accomplished by sealing for one minute or longer, in a special sealer at 180°F. to 210°F. then water rinsing. This substitutes for the nickel acetate seal.

Lustrous basis metal finishes are maintained without the substantial dulling that takes place during long time conventional anodizing. Surfaces are not softened or back-etched.

High-Purity Cadmium Plating Solution

Fisher Scientific Co., Dept. MF, 717 Forbes Ave., Pittsburgh 19, Pa.

Manufacturers of solid-state electronic components who plate semi-conductors with cadmium are now offered high-purity cadmium fluoborate solution, direct from stock.

Unwanted metal atoms can, of course, completely upset the electronic behavior of transistors, thermistors, masers, other solid-state units. The new certified reagent-grade cadmium fluoborate solution has been brought to a new low in impurity content (example: silver is kept below 0.00003%, copper below 0.00005%). Every lot meets purity specifications, drawn to conform to electronic requirements, it is claimed.

Nylon Mesh Parts Bag

Henry S. Haupt, Dept. MF, P.O. Box No. 76, Rugby Sta., Brooklyn 3, N. Y.

Rust contamination from metallic baskets is eliminated with the Niagara Nylon mesh container, a sturdy drawstring bag. Solvents are said to drain completely and no solid areas are present for contaminants to accumulate.

This industrial container has unlimited applications in a variety of technical operations including degreasing, washing, ultrasonic cleaning, and storage. Its advantages, according to the manufacturer, are long life, chemical inertness, resistance to solvents, flexibility, ease of cleaning, and freedom from maintenance and storage problems.

The containers are stocked in a number of meshes and sizes for maximum versatility and can be made to any size, shape, or mesh, according to specifications.

Vibratory Finisher

Rampe Mfg. Co., Dept. MF, 14915 Woodworth Ave., Cleveland 10, Ohio.

A basic new-type vibratory machine for precision tumble finishing work, the Vi-brader machine features a unique, controlled orbital motion, and increases cutting speed up to 90% faster than conventional methods, also providing much longer tub life, it is claimed.

The 1¼ cu. ft. Model 10, first of five models to be completed, has a variable speed drive to permit orbital control of abrasive load not possible with existing equipment. The machine is exceptionally rugged, compact, and low in first cost as well as operating cost.

Manufacturers' Literature

Nickel Sulfamate Plating

Hanson-Van Winkle-Munning Co., Dept. MF, Church St., Matawan, N. J.

A 16-page technical instruction bulletin describes the company's nickel sulfamate process, the most suitable bath for heavy build-up for metal resizing, electroplating, electroforming, and other functional uses.

The bulletin illustrates (with photomicrographs and charts) and completely describes solution preparation for both still and barrel operations; effects on deposits of using various proportions of solution's constituents, effective temperatures, current densities and voltage requirements; purification methods; analytical procedures for constituents; equipment and materials needed to successfully operate the nickel sulfamate bath.

Industrial Wastes

Industrial Filter & Pump Mfg. Co., Dept. MF, 5900 Ogden Ave., Cicero, Ill.

"Continuous and Batch Treatment of Industrial Wastes," an article reprinted from METAL FINISHING, outlines design criteria and requirements for waste treatment, both continuous and batch, of cyanide and chromate solutions; neutralization and solids removal.

Pearl Pigments

Rona Pearl Corp., Dept. MF, E. 21st St., Bayonne, N. J.

A complete technical brochure contains general discussion concerning the properties of pearl pigments, problems of orientation and techniques, types

available and other pertinent data.

A separate chart lists each product, its properties and use which enables a prospective user to select a product most suitable for his specific use based on chemical and physical stability, compatibility, luster, and brilliance.

Chromating Selector Chart

MacDermid, Inc., Dept. MF, Waterbury, Conn.

A new selector chart enables a metal finisher to match the proper chromate coating to the type of finish desired. In addition to showing the type of finish desired, the chart indicates the color of various coatings, refers to the appropriate data sheet number and lists the government specification number met by the company's three dry powdered chromate conversion coatings.

Chemical Cleaning Unit

Pall Corp., Dept. MF, 30 Sea Cliff Ave., Glen Cove, N. Y.

Literature on a new type of low-cost metal parts chemical cleaner shows a photograph of the cleaner and also shows an exploded view with all basic parts noted. Pall-Clean solutions, which are capable of finishing stainless steel, Monel, nickel and aluminum surfaces to high levels of brightness and cleanliness, are described.

Filter Cartridges

Cuno Engineering Corp., Dept. MF, 80 S. Vine St., Meriden, Conn.

Bulletin MW-100, on the new Micro-Wynd disposable filter cartridges, describes the patented manufacturing process by which a separate filtering medium is interwoven between the structural spiral windings, on a perforated metal core.

Performance advantages, user test reports, micron densities, fluid compatibility and other specifications are included.

Vacuum Diffusion Pumps

NRC Equipment Corp., Dept. MF, 160 Charlemont St., Newton 61, Mass.

A new 12-page catalog contains basic descriptive information on diffusion and booster pumps, shows speed curves for small, medium and large models ranging from 1 to 32-inch sizes, and includes both tabular specifications and outline drawings for each pump. Liberal use of color with cross-sectional and outline drawings makes the catalog easy to use and understand, while the tabular and performance data, plus special information on the theory of diffusion pumps and their operation at very low pressures, make it ideal for reference when designing vacuum systems or checking on their performance.

Abrasive Blasting

Pangborn Corp., Dept. MF, Hagerstown, Md.

Bulletin No. 227A tells how the Rotoblast impeller uses controlled centrifugal force for its blast cleaning power. The revised eight-page booklet contains diagrams and cut-away drawings showing the latest design refinements. The booklet describes many new modifications developed to increase production speed yet reduce cost of operation.

Ultrasonic Cleaning

National Ultrasonics Corp., Dept. MF, 111 Montgomery Ave., Irvington 11, N. J.

A new catalog, No. 60, is available on industrial ultrasonic cleaning methods.

Polyethylene Tanks

American Agile Corp., Dept. MF, P.O. Box 168, Bedford, Ohio.

A comprehensive two-page data sheet offers detailed information on a new line of standard size, Thermofusion molded polyethylene tanks.

Process Equipment

Pfaudler Div., Pfaudler Permutit Inc., Dept. MF, Rochester 3, N. Y.

The new 1961 "Fluidics" Buyers Guide explains the science of fluid processes, plus specialized materials and equipment, for handling and processing more profitably the liquids and gases used by industry. The guide is divided into two sections, one dealing with Pfaudler products and the other with Permutit products. Each section is illustrated with application photos and concise engineering data.

Chemical Resistant Floors, Linings and Coatings

Ralph V. Rulon, Inc., Dept. MF, 3900 N. Second St., Philadelphia 40, Pa.

A new illustrated eight-page catalog, No. 604, describes thirty corrosion resistant materials and their applications.

Solvent Vapor Recovery

Vic Manufacturing Co., Dept. MF, 1313 Hawthorne Ave., Minneapolis 3, Minn.

A four-page, illustrated brochure is available on the above firm's solvent vapor recovery systems which gives their advantages, complete specifications, and several testimonials from satisfied users.

Solvent Degreasers

Ramco Equipment Corp., Div. Randall Mfg. Co., Inc., Dept. MF, 1373 Lafayette Ave., New York 59, N. Y.

Bulletin #655 is a six-page illustrated brochure featuring two and three stage solvent degreasers. Information is given on how the degreasers work, their uses, cleaning cycles, and extra features.

Gas-Fired Infra-Red Burner

Bryant Industrial Prods. Corp., Dept. MF, 17700 Miles Ave., Cleveland 28, Ohio.

A 4-page data sheet on a new gas-fired infra-red burner contains application data and performance curves for evaluation, selection, and specifications.

Plastic Sheets

Plastics Div., Seiberling Rubber Co., Dept. MF, Newcomerstown, Ohio.

A four-page brochure is available on Seilon plastic sheets. Information is contained on the thermoplastic sheetings of the unplasticized type put out by the above firm, plus packing data and uses for each.

Electrical Heater

Electrical Accessories Co., Chemical Equipment Div., Dept. MF, 744 Broad St., Newark 2, N. J.

An illustrated bulletin, Process Equipment News No. 1, is available on Heat-Pak, a new heater for corrosive liquids. Its features and advantages are given, plus diagrams of three models showing dimensions, and specification tables.

Solution Filter

Croll-Reynolds Engineering Co., Dept. MF, 1122 Main St., Stamford, Conn.

An eight-page brochure about the ClaRite filter and its operation offers pictorial evidence of the element's filtration ability.

BUSINESS ITEMS

O'Hanlon Named by Meaker

Lawrence O'Hanlon, formerly chief designer with Titeflex, Inc. and their successor in the filter field, Croll-Reynolds Engineering Co. since 1949, has been appointed chief design and application engineer for their filter division by *The Meaker Company*.

Lawrence O'Hanlon

Mr. O'Hanlon, who attended California Institute of Technology and the University of Oregon, concentrating in Mechanical Engineering, has held responsible technical and administrative positions in industry since 1938, including assignments with Western Electric Co., General Machine Co., Metalwash Machinery Co., and Randall Mfg. Co. He has also served as a design consultant to the processing industry. In his positions with Titeflex and Croll-Reynolds, Mr. O'Hanlon had complete responsibility for design, estimation, fabrication, installation and service of chemical filtration systems. Mr. O'Hanlon will make his headquarters in Nutley, N. J.

Du Pont to Consolidate Production of "Tri" Solvent

The *Du Pont Co.* has announced plans to consolidate production of trichlorethylene solvent in recently modernized facilities at its Niagara Falls, N. Y., plant. This move will result in the closing of the company's other "tri" production unit at Wyandotte, Mich., on January 31.

The Wyandotte plant, which employs 42 persons, has been made obsolete as a result of a new process for "tri" and perchlorethylene. Manufacturing efficiencies resulting from a modernization program at Niagara Falls will enable the company to compete more effectively against lower priced imports of "tri" which have nearly doubled in the past two years, it is said.

Narcus Named Consultant to Enthone

Harold Narcus, president and technical director of *Electrochemical Industries, Inc.* of Worcester, Mass., has been retained by *Enthone, Inc.* of New Haven, Conn., as a consultant in all phases of plating on non-conductors. Dr. Narcus will assist both the firm and its customers with problems involving electroless plating, plating on plastics and ceramics, and the cleaning and plating of printed circuits.

Dr. Narcus received his Master of Science degree from Worcester Polytechnic Institute and Ph.D. degree in organic chemistry from Clark University. He has specialized in plating on plastics for over 25 years, and several patents relating to the metalizing of non-conductors have been issued to him in the United States, Canada, and Great Britain. He is the author of a book entitled "Metallizing of Plastics," and of numerous papers on this subject. In 1945, he originated the plated-through hole process in printed circuitry using a copper film.

Dr. Harold Narcus

Dr. Narcus is a member of Sigma Xi, honorary scientific fraternity. He is a past president of the Boston Branch of the A.E.S. His other memberships include the American Chem-

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faster, full-view filtration for all corrosive solutions

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- easy, trouble-free operation
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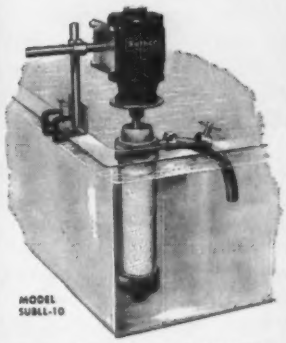
- fits anywhere on tank — saves floor space, no "jockeying" with hose lines
- high speed ⅙ hp motor for faster flow
- completely corrosion resistant
- quality-built throughout yet costs ⅓ less than heavier, cumbersome types



Sethco — famous for many firsts in filtration systems — now offers a completely new concept in a submersible type unit. Designed for filtering plating and chemical solutions without "product" loss, the new SUB series represents the ultimate in reliability and economy. Only Sethco provides a choice of construction for universal applications: for acids and alkalies — lucite and epoxy with SS #316 fittings; for temperatures above 140°F. — epoxy and full-view pyrex shell replaces lucite; for high chlorides — epoxy or titanium replaces SS #316.

Write or call for Spec Sheet No. 551

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MAyfair 3-4220

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ical Society, The Electrochemical Society, and the American Society for Testing Materials. He is a registered professional engineer in the state of Massachusetts.

H-VW-M Promotes Herring

Hanson-Van Winkle-Munning Co. has announced the appointment of *Glenn M. Herring* to the position of assistant sales manager. This follows and supersedes his appointment earlier this year as assistant to the vice-president—sales.

Glenn M. Herring

In his new capacity Mr. Herring will be assigned to general company sales responsibilities with particular emphasis on equipment negotiations. In that area, he will assist field personnel with home office cooperation and will maintain constant liaison with the engineering department. He will continue to be in charge of the Eastern sales district.

Mr. Herring joined the firm in 1930 as a sales trainee. He was appointed sales representative to the Pittsburgh area upon completion of this course. In 1955 he transferred to the home office in Matawan and was appointed manager of steel mill sales. Three years later, he was appointed to the post of district manager — Eastern states (Maine to Florida).

Mr. Herring, a graduate of Lafayette College, received his B.S. in 1930. He is an active member of the A.E.S., Association of Iron and Steel Engineers and the University Club of Pittsburgh, Pa.

New Service Announced by J. Holland and Sons, Inc.

A free technical layout service to be offered to those interested in new electroplating plant installations or additions to existing plants has been announced by *J. Holland & Sons, Inc.*, 475 Keap St., B'klyn 11, N. Y. *Ralph Lee* has been appointed director of the newly-formed department.

Mr. Lee has been associated with the firm for 13 years and has supervised the installation and operation of hundreds of electroplating operations in captive companies as well as job shops. His work in this area has taken him to practically every major metal working center in the U. S. and Central and South America.

Previously, Mr. Lee served in the Electroplating Division of E. I. Dupont De Nemours in Wilmington, Del. for 22 years. During the war he was on special assignment with Special Chemicals Corp. of New York City active in the development of highly technical and precise electroplating materials.

G. S. Equipment Acquires Production Facilities

G. S. Equipment Co., leading producer of plating barrels and corrosion test cabinets, has announced the acquisition of complete product development and manufacturing facilities. The firm will now develop and manufacture its entire product line in a modern, well-equipped plant at 15583 Brookpark Road, Cleveland 35, Ohio.

Diamond Alkali Promotes Honour

Appointment of *Stanley B. Honour* as sales manager, International Division, has been announced by *Diamond Alkali Co.*, New York.

Serving as export sales manager, agricultural chemicals, for the past nine years, Honour acquired considerable export experience prior to joining Diamond, with the Sherwin-Williams Co. and other leading corporations. A member of the National Credit Bureau, Honour received his education at Rutgers University.

Cleveland Office for Selas Moves

Selas Corp. of America, Dresher, Pa., announces that the company's Cleveland sales district headquarters has been moved to 6025 Mayfield Road, Cleveland 24, Ohio. The telephone number for the new office, which is headed by *T. G. Thurston*, is HIllcrest 2-6655.

Nordson Training School Dates for the First Half of 1961

The Nordson Training School, covering the operation and maintenance of airless spray painting equipment, is being expanded in 1961. The school conducted by *Frank Ziroe*, technical service director, features instruction in the use and maintenance of airless equipment, emphasizing both theory and practice. In addition, sessions cover modern coating materials and their application problems. The class is divided between lectures and practice work sessions using the facilities of the company's laboratory.

School dates for the first half of 1961 follow:

January, 1961	10-13
February	14-17
March	14-17
April	11-14
May	9-12
June	13-16

The size of individual classes is limited, so it is advisable for those wishing to attend to make application as far as possible in advance. Tuition is free. Anyone generally interested in airless spray may attend. Application blanks may be obtained from the *Nordson Corporation*, Amherst, Ohio.

M&T Appoints New Superintendent in Coatings Division

Walter C. Archinal

The appointment of *Walter C. Archinal* as superintendent of coatings production at *Metal & Thermit Corp.'s* Carrollton plant was announced recently.

Mr. Archinal has been associated with the company's Coatings Division

since 1959 as a research chemist. He was graduated from Adelphi College with the degree of B.S. in chemistry. Prior to joining M&T, Mr. Archinal was employed as a chemist by the Rubber Corp. of America.

General Electric Appoints Shambach

Walter N. Shambach has been named manager of marketing and product development in the Heaters and Devices Section of *General Electric Co.'s* Industrial Heating Department, Shelbyville, Ind.

A native of Camp Hill, Pa., Shambach joined the company in 1942, after being graduated with a B. S. degree in Electrical Engineering from Penn State University. After engineering test assignments in Philadelphia, and Erie, Pa., and Schenectady, N. Y., he became a requisition engineer for the Industrial Control Division in Schenectady in 1943.

From 1946 through 1947 he was a proposition engineer with the company's Induction Motor Department. For five years, he was an industrial control specialist in the Philadelphia sales office.

In 1954 Shambach became a product planner at the General Purpose Control Department in Schenectady and, when that department transferred to Bloomington, Ill. in 1954-1955, he moved with it. He was named manager-device production engineering at Bloomington in 1956. In 1957, Shambach was named manager of sales to original equipment manufacturers at the General Purpose Control Department, the post he held until his present assignment.

Minnesota Mining & Mfg. Co. Erecting Plant in Australia

Plans for the construction of a coated abrasives plant in Australia have been announced by *Minnesota Mining & Mfg. Co.* The company revealed that its Australian subsidiary will soon begin construction on the new plant, to be located at the site of the present Australia plant at St. Mary's, New South Wales. It is expected the plant, which will have about 40,000 square feet of floor space, will be in production early in 1962.

The present production facilities occupy nearly 90,000 square feet and are devoted to manufacturing and converting operations for a wide variety of products.

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CEILCOTE E-900
. . . dependable coating for severe corrosion service!
COROBOND
. . . acid-proof cement used with Ceilcote Brick!
CEILCRETE
. . . combined with glass cloth for extreme chemical resistance!
COROCRETE
. . . monolithic flooring four times stronger than concrete!

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ENGINEERED FLOORS

Ceilcote *Engineered Floors* are the answer to costly floor maintenance problems caused by acid and alkali attack. And Ceilcote floors are engineered to withstand impact, thermal shock, abrasion and expansion without cracking or spalling! The installation shown above exemplifies Ceilcote's comprehensive approach to individual flooring problems . . . demonstrates how Ceilcote materials are carefully integrated to completely protect all types of surfaces. Working under contract, competent Ceilcote engineers analyze your operating conditions . . . formulate materials . . . direct surface preparation and installation by Ceilcote construction crews. Some installations can be installed under Ceilcote supervision or by plant personnel. *This complete flooring package with guaranteed performance is available only from Ceilcote!*

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ALABAMA: BIRMINGHAM LY. 2-7201. CALIFORNIA: OAKLAND TE. 2-0103, SANTA ANA P.O. BOX 625. COLORADO: DENVER GL. 5-3651. WASHINGTON, D.C. OL. 6-4321. FLORIDA: CORAL GABLES MO. 5-1965. ILLINOIS: CHICAGO AN. 3-1881. INDIANA: EVANSVILLE HA. 3-3597. MASSACHUSETTS: SPRINGFIELD RE. 6-5203. MICHIGAN: DETROIT UN. 4-6871. MISSOURI: KANSAS CITY MI. 9-1312. NEW JERSEY: PRINCETON WA. 1-6969. NEW YORK: NEW YORK CO. 7-0276, ROCHESTER GR. 3-5918. N. CAROLINA: CHARLOTTE JA. 3-8784. OHIO: CINCINNATI EL. 1-5765, CLEVELAND ER. 1-4558. PENNSYLVANIA: PHILADELPHIA KI. 5-0720, PITTSBURGH AT. 1-8500. TENNESSEE: KNOXVILLE 2-5770. TEXAS: HOUSTON JA. 2-1606. WASHINGTON: SEATTLE SU. 3-9200. CANADA: OTTAWA CE. 3-7785.

Simmons Plating Appoints Rosenberg

Simmons Plating Works, Inc. of Atlanta, Ga., announces the appointment of *Allan J. Rosenberg* as assistant manager. He will also be in charge of quality control.

Mr. Rosenberg, a graduate of Massachusetts Institute of Technology, obtained his B. S. degree in metallurgy and was formerly connected with Union Carbide at Oak Ridge, Tenn.

Technic Names Technical, Research Directors

Promotions of *Dr. Edward A. Parker* to technical director and *James A. Powers* to research director of Technic, Inc., were announced recently.

Parker has been with the Providence-based firm, one of the nation's largest producers of solutions for electroplating with gold, platinum, rhodium, and palladium, since 1945. Powers joined the company in 1957, and succeeds Parker as research director. The post of technical director is newly created.

Before joining the firm, Parker was associated with Alrose Chem. Co., Cranston, R. I., for three years. He received his bachelor's, master's, and doctor's degrees from the University of Illinois.

Parker is a member of the American Chemical Society, The Electrochemical Society, American Society for Testing Materials, American Electroplaters' Society, American Institute of Chemists, Institute of Metal Finishing in England, and Sigma Xi scientific fraternity.

Powers, who was research chemist

Dr. Edward A. Parker

James A. Powers

on the company's staff before his promotion, previously was associated with Olin Mathieson Chem. Corp. and Geigy Chem. Corp.

A member of the American Electroplaters' Society and American Chemical Society, he has a bachelor's degree from Providence College and master's degree from the University of Notre Dame. He was graduated Magna Cum Laude from Providence and held a teaching fellowship at Notre Dame.

Ebers V.P. of Chemical Operations at U. S. Rubber

The board of directors of *United States Rubber Co.* has designated *Earle S. Ebers* as group vice-president in charge of the polymer, fiber and chemical operations of the company. Mr. Ebers had been vice-president and general manager of the company's Naugatuck Chemical division. At the same time, the board elected *Dudley Chittenden* a vice-president of the company and appointed him general manager of the Naugatuck division to succeed Mr. Ebers.

Mr. Ebers joined the company in 1937 as a research chemist in its general laboratories. He received his bachelor of science degree in chemistry from Dalhousie University in Halifax, continued his chemistry studies at Harvard University, and received his Ph.D. degree there in 1936.

Mr. Chittenden, who joined the company in 1926, also started in the company's general laboratories as a research chemist. A native of New Haven, Conn., Mr. Chittenden attended secondary schools there. He then entered Yale University where he obtaned hs B.S. and Ph.D. degrees in chemical engineering.

Pittsburgh Plate Promotes Grunewalder

Appointment of *Valentine J. Grunewalder* as technical director for the Newark paint factory of *Pittsburgh Plate Glass Co.'s* paint and brush division has been announced by the company. He succeeds *Morris G. Gardner*, who has retired after 25 years of service in the technical organization at the Newark factory.

A native of Irvington, N. J., Mr. Grunewalder joined the firm in 1941 as a chemist at Newark and, since 1954, had served as assistant technical director. He is a graduate of Rutgers University and a member of the American Chemical Society and New York Paint and Varnish Production Club.

Rapid Electric Announces Two Appointments

Rapid Electric Co. announces the addition of two new men to its staff, *Gerald D. Coen* and *Donald T. Creaven.*

Mr. Coen brings twenty years of diversified mechanical-electrical engineering experience to the firm. He received his engineering education at Castelknock College, Dublin, Ireland,

Gerald D. Coen

and served twelve years as test engineer with the English Electric Co. His diversified abilities and qualifications provide engineering depth as assistant to the chief electrical engineer. Mr. Coen will be engaged in design engineering for research development programs.

Mr. Creaven has joined the engineering department as technical service manager. His background includes eight years of rectifier service work and four years of USAF electronic

training. He will supervise the drafting of technical manuals, electrical data and preventive maintenance bulletins.

Wyandotte Breaks Ground for Canadian Plant

Ground was broken recently for the new *Wyandotte Chemicals Corp.*, J. B. Ford Division plant in Scarborough Township, near Toronto, Ontario. The new plant will manufacture the com-

plete line of cleaning, washing and sanitizing products.

The manufacturing portion of the plant will occupy some 48,000 square feet. An office of 4,000 additional square feet is also provided. The site will accommodate additional plants for expected growth.

Johnstone Promoted By Hercules

Paul L. Johnstone has been named assistant general manager of *Hercules Powder Co.'s* Cellulose Products Department. He succeeds *Werner C. Brown*, who has been named general manager of the department.

Mr. Johnstone has been director of development for the department since 1956. A native of New Jersey and a graduate of Princeton University, he joined the firm in 1940 as a chemist at the research center near Wilmington. He served in the Navy for three years as a lieutenant, seeing duty in the Mediterranean and Pacific. Later in 1945 he returned to the company to work in the market development division of the Synthetics Department, of which he was named manager in 1950. He was made director of development for synthetics in 1952.

Promotions at Detrex

Detrex Chemical Industries, Inc. announces several major management promotions in their Industrial Sales Division.

Effective immediately, *Gordon A. Jacobs* will assume the duties of sales manager in the division. *Paul W. Moehle* has been appointed product manager of industrial solvent sales and coordinator of jobber relations.

Product: 99.75+% Pure
Service: 100% Sure

Every batch checked. Every can filled with a full weight of extra high quality 99.75+% Chromic Acid. Prompt delivery from ample factory and nearby distributor stocks. Why not order BFC Chromic Acid next time?

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Paul W. Moehle

Gordon A. Jacobs

David E. Williard

Bruce A. Young has been appointed product manager of industrial equipment sales.

David E. Williard has been appointed special assistant to *E. W. Allison*, vice-president of sales.

Acoustica Appoints Houghton

Appointment of *Richard B. Houghton* to the newly-created position of vice-president-engineering for the California operations has been announced by *Acoustica Associates, Inc.*, manufacturer of ultrasonic cleaning, gauging and control systems.

Houghton, who joined the company in 1958 as assistant program director, formerly was associated with Convair in San Diego as head of the propellant utilization group for the Atlas missile; with Bill Jack Scientific Instrument Co., and Ryan Aeronautical Co.

A graduate of the U. S. Naval Academy with a B.S. degree in general engineering, Houghton also has done graduate work in electronics at UCLA.

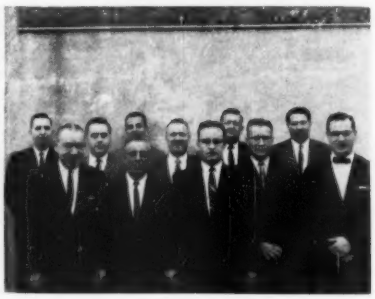
Richard B. Houghton

Hapman Acquires Econ-O-Veyor Corp.

The acquisition of the *Econ-O-Veyor Corp.*, Glen Cove, N. Y. by the *Hapman Corp.*, Kalamazoo, Mich., was announced recently. It will operate as a division of Hapman and the manufacturing facilities will be moved to the latter's plant in Kalamazoo. *John Leach*, formerly president of Econ-O-Veyor, becomes vice-president in charge of the division and will be a Hapman director, it was announced. He will headquarter in New York City.

J. J. Siefen Holds Sales Meeting

Present at a recent sales meeting in Detroit of the *J. J. Siefen Co.*, composition and finishing systems manufacturer, were: front row — *Ben P. Sax*, president; *Eldon Brisson; Ralph Hale*, general manager; *Alfred Darnell; Stanley Sax*. Back row — *Harold Swartz, Louis Misenti, Ronald Greiner, Victor McBride, Cameron Elliott, Travis Bernstein.*



Foran Joins Graphik-Circuits Staff

Nelson Foran recently joined the management staff of *Graphik-Circuits*, a division of Cinch Mfg. Co., as assistant to the vice-president and general manager. Previously, he was a member of the research and development staff of Photocircuits Corp., Glen Cove, N. Y.

Mr. Foran attended New York University and Brooklyn Polytechnical Institute of Technology. During World War II he served in China as a Naval Intelligence Officer. In 1946, Mr. Foran joined the Specialized Plating Co. of Brooklyn, N. Y., where he acquired a valuable background of practical plating experience. He later joined the staff of Fairchild Engine Co., where he supervised work for the Atomic Energy Commission and the operation of the largest nickel plating installation in the East.

He is presently engaged in the development of new and improved plating methods for high reliability printed circuits.

Nelson Foran

Oakite Names Tucker Assistant Sales Manager

Ken C. Tucker, formerly manager of the food industries division of *Oakite Products, Inc.*, has been named assistant sales manager of the firm, which manufactures specialized chemical compounds for industrial cleaning and metal treating.

Mr. Tucker was educated at New York University and has been with the company since 1945. A member of the Society of Soft Drink Technologists, American Society of Bakery Engineers, and the Institute of Sanitation Management, Mr. Tucker has served

Ken C. Tucker

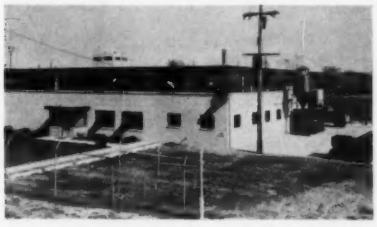
on many industrial committees and has presented papers before many association meetings. One of his major responsibilities in his new post will be the servicing of national accounts. He will report to *William A. Baltzell*, vice-president and sales manager.

New Facilities for Wayne Products

Wayne Products Corp. announces that new facilities are being built at 623 W. Colfax St. in Palatine, Ill., as part of a program to extend and improve service to their customers. The firm manufactures a complete line of filters designed expressedly for the plating industry.

Whitfield Chemical Builds New Plant

Whitfield Chemical Co., Inc., announces that the main offices and manufacturing facilities are now at 9100 Freeland Ave., Detroit 28, Mich. This



new plant is located on a 3½ acre site with railroad siding and 5 loading docks, contains 20,000 sq. ft. of manufacturing and storage space, and is designed primarily for the manufacture of metal cleaning chemicals. New and improved laboratory and research facilities are included.

Michigan Buff Appoints Payson

Anthony Payson has been assigned the New York and New England territory for *Michigan Buff Co.*, Detroit manufacturer and distributor of polishing, buffing and abrasive equipment and supplies.

Mr. Payson, who graduated from Michigan State in 1959, joined the firm after his military service.

Pillsbury Chemicals in New Location

Pillsbury Chemicals, manufacturer since 1946, with national representation, of stamping compounds, cutting coolants, metal cleaners and rust preventatives, has moved to new and larger quarters at 14066 Stansbury, Detroit, Mich.

The new plant makes possible a considerable enlargement of laboratory facilities devoted to chemical research and development.

DAVIS-K GOLD PLATING SOLUTIONS

. . . LEADER in Electrolytic Precious Metals!

ONE OPERATION
Antique Gold Solution

- GOLD LIQUID CONCENTRATE
- POTASSIUM GOLD CYANIDE SALTS
- LUSTROUS WHITE RHODIUM SOLUTION
- VARIABLE-TYPE TANK RHEOSTATS — SPECIALLY DESIGNED FOR PRECIOUS METAL PLATING.

ALL DAVIS-K GOLD PLATING SOLUTIONS ARE:

- Made in all colors
- Color constant
- Tarnish-resistant
- Brilliant in finish
- Bottled by Troy Weight
- Made from U. S. Treasury Gold only
- Ready for immediate use

AUTHORIZED DISTRIBUTORS OF
SEL-REX PATENTED KARATCLAD
ACID BRIGHT GOLD PLATING PROCESS

We are fully equipped to reclaim old gold and rhodium solutions. No charge for small sample plating.
Write Dept. MF for details.

FREE Consultive Service
Call on Davis-K process engineers for help with your special plating problems and installations.

"Where Glittering Elegance Reflects Lasting Quality."

100% PURE GOLD DKP SOLUTIONS

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Hanson-Van Winkle-Munning Holds Sales Education Meeting

Group shot shows members of H-VW-M Sales Force who attended the H-VW-M Sales Education Meeting, held October 17-19 at Hershey, Pennsylvania. The three-day session consisted of 24 hours of lectures and technical discussions of the company's new processes, and equipment and the extensive research and development program.

From left to right, are: Bottom Row — *R. Bauer, W. J. Harper, G. K. Robins, E. E. Carlson, W. M. Teets, H. B. Koehler, M. B. Diggin, G. M. Herring* and *R. E. Waite*. Second Row — *R. E. Creamer, A. C. Pearson, C. E. A. Solla, C. T. Peebles, C. E. Campbell* and *W. H. Brown*. Third Row — *W. R. Lockwood, H. F. Allen, E. C. Bosl, T. E. O'Callaghan, R. M. Norton, P. C. Burnham* and *M. A. Tardiff*. Fourth Row — *J. A. Badaluco, R. R. Granquist, T. M. Rodgers, W. A. Mercer* and *F. Badaluco*. Fifth Row — *C. R. Smith, H. L. Grutter, J. S. Hart, A. A. Nortof, W. J. Slattery, Jr.* and *C. A. Pickering*. Sixth Row — *R. K. Martin, J. P. Muscarella, Jr., W. L. Guiltinan, F. H. Dayton, J. D. Kershaw* and *D. H. Morris*. Back Row — *R. G. Marshall, W. M. Pike* and *W. S. Wilkinson*.

Jefferson Chemical Appoints Manager of West Coast Sales District

R. V. Boyce has been appointed district sales manager in charge of *Jefferson Chemical Co.'s* newly created West Coast sales district, which encompasses the seven western states of Washington, Oregon, California, Arizona, Utah, Nevada and Idaho.

Mr. Boyce is a graduate of Catholic University of America, Washington, D. C., with an A.B. degree in chemistry. He has also attended the University of Vermont. In 1954 Mr. Boyce joined the firm as a salesman in the New England area, and occupied this position until his recent promotion. Previously he was associated with Dow Corning Corp. and Pratt & Whitney Aircraft.

Management Changes at Lord Chemical

Operating management changes at *Lord Chemical Corp.* of York, Pa. were reported recently. *H. R. Stitely* resigned as president, but will continue as a director and a consultant, and *Paul H. Setzler* was named vice-president and general manager. Mr. Stitely is succeeded by *James F. Connaughton*.

Mr. Setzler, who has had more than 25 years of manufacturing and engineering experience, joins the firm from a manufacturing consulting assignment for Baldwin-Lima-Hamilton Corp. Previously, he served as vice-president in charge of manufacturing for the Boiler Division of the Babcock & Wilcox Co., Barberton, Ohio and served from 1945 to 1957 as works manager of the Hamilton, Ohio division of Baldwin - Lima - Hamilton Corp. From 1937 to 1945 he was works manager of Lukenweld, Inc., after beginning his industrial career as a development engineer for Lincoln Electric Co. in 1933.

Mr. Setzler has a BS degree in mechanical engineering from Colorado State University and a masters degree from Cornell University. He is a member of the Ohio State and National Society of Professional Engineers and of the American Society of Mechanical Engineers.

Paul H. Setzler

Bzura Appoints Director of Commercial Development

Bzura Chemical Co., Inc. announces the appointment of *Gerald J. Bayern* as director of commercial development. He was previously manager of market research of the chemical group of W. R. Grace & Co.

Mr. Bayern is a member of the American Chemical Society, Chemical Market Research Assn., Commercial Chemical Development Assn., American Marketing Assn. and the Chemical Industry Assn. He is a Fellow of the American Institute of Chemists and a Professional Member of the Packaging Institute.

After service in World War II, Mr. Bayern received the A. B. degree in

Gerald J. Bayern

Chemistry from Columbia University and the degree of Master of Business Administration from Cornell University. He has previously been associated with American Cyanamid Co., Foster D. Snell, Inc. and Allied Chemical Corp.

Hyner in Top Post At Whyco Chromium

The board of directors of *Whyco Chromium Co., Inc.*, Thomaston, Conn., has elected *Jack Hyner* to the positions of president and treasurer effective immediately. Mr. Hyner subsequently appointed *William E. Taylor*, plant manager; *Gerard Miclette*, production manager; *William Radzunas*, plating superintendent; *Ralph Cappella*, traffic manager; and *Elizabeth Zorsky*, office manager, of the one-hundred-employee company which

Jack Hyner

specializes in barrel and rack volume chromium plating of small parts, and barrel copper and nickel plating to specifications.

Mr. Hyner co-founded the firm with the now retired *Howard C. White* in 1946, in Waterbury. At that time the payroll included two employees. Mr. Hyner was born in Brooklyn, N. Y., attended schools in that area, and was graduated in 1937 from C.C.N.Y. with a B.S. degree in chemistry.

Pangborn Names Stedman Manager

Pangborn Corp., Hagerstown, Md., has named *Linwood A. Stedman* manager of the New England district with offices in Springfield, Mass. Formerly sales engineer in Springfield, he succeeds *John H. Connolly* who retired

Linwood A. Stedman

recently after more than 22 years as district manager.

Hull to Distribute Singleton Line

R. O. Hull & Co., Inc., electroplating specialist of Rocky River, Ohio, has announced that it is now associated with *Albert Singleton* of *The Singleton Co.*, a firm active in the field of plating equipment manufacture since 1946.

Singleton at New Address

Singleton Company is now located at 11770 Berea Road, Building B, Cleveland 11, Ohio, telephone: CLearwater 1-5580.

New Container Protects Technic Products in Transit

A new container to minimize the possibility of shipping damage to its products has been adopted by *Technic, Inc.*, Providence, R. I., producer of gold, platinum, rhodium, and palladium solutions for electroplating. The

container, of lightweight expanded plastic, provides secure "nests" for four bottles of precious metal solutions. The bottles fit securely into scooped out spaces in the plastic to prevent joggling in transit while the thick sides of plastic prevent damage from the exterior. The container is sealed with a nylon band.

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Coating users, on the alert for something different to make their products stand out, will be interested in Nacromer coatings because they are different . . . because they add unusual beauty . . . and, because they're easy to use.

If you are looking for a new distinctive finish, why not try Nacromer?

NEW 8-PAGE HANDBOOK

Our new 8-page Nacreous Pigment Handbook and 4-page "Coating with Nacreous Pigments" brochure contain much valuable information on the use of Nacromer. Write for your copies today.

THE MEARL CORPORATION
41 EAST 42nd STREET, NEW YORK 17, N.Y.

NEWS FROM CALIFORNIA

The new plant in Anaheim, Calif., into which the Hyer Hardware Co. of Los Angeles moved recently, is equipped with a plating department which now enables the firm to finish in its own plant the door pulls, hinges and other building hardware which it manufactures.

The new plating division is equipped with plating, polishing and buffing facilities which Hyer acquired when it bought out the Eagle Plating Co. of Los Angeles. Facilities for plating with brass, bronze, chromium, and nickel are available.

Robert Berry, formerly with Carlson Rule Co., a manufacturer of metal rules in Monrovia, Calif., has been named plating foreman. *Fred Allen* succeeded to Berry's former post with Carlson.

The facilities of the Compton, Calif., plant of Autonetics, Inc., a division of North American Aviation, were expanded recently by the installation of a complete printed circuit unit for use in processing military and guided missile systems. Included are tooling and gray processing facilities, silk screening and complementing equipment pieces. Four 65-gallon gold plating tanks and two 300-gallon pyrophosphate copper and electroless copper tanks have been installed plus cleaning and etch tanks.

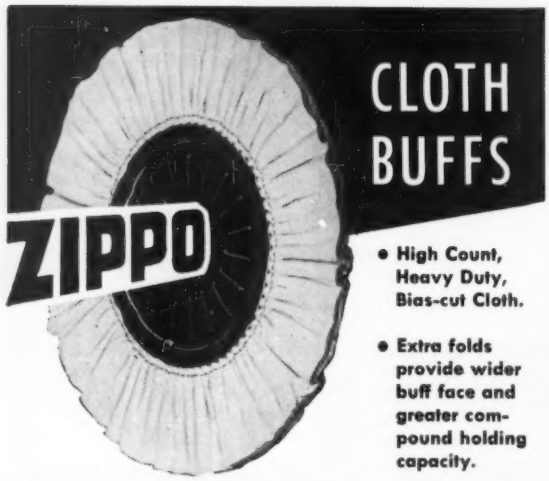
The facilities of the Autonetics plant in Downey, Calif., have also been enlarged by installation of an electroless nickel unit for plating on beryllium.

Keystone Plating Co. of North Hollywood, Calif., which specializes in plating automobile bumpers, recently established a branch plant in Cleveland, O., to facilitate service to midwestern customers. The firm operates other branch plants in St. Louis, Mo., White Plains, N. Y., and Newark, N. J. *Ray Bleiweiss* of Los Angeles is president and owner. The firm was originally established by *Al Crams*. Bleiweiss joined him as a partner in 1958 and, in mid-Summer of 1960, acquired Cram's interest.

Kenneth P. Bellinger, president, Coversion Chemical Corp. of Rockville, Conn., was on the west coast on a business trip in mid-November, in the course of which he addressed several branches of the A.E.S. on the latest developments in the chemical conversion plating field.

He addressed Los Angeles and Vancouver branches, but a talk scheduled before Seattle Branch was called off due to election night conflict. Mr. Bellinger also conferred with his firm's western distributors — Van Water Reynolds Co. in Seattle and Portland, and Alert Supply Co. in San Francisco and Los Angeles.

The appointment of *J. George Warneck* as sales engineer assigned to their Los Angeles office has been announced



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FORMAX BUFFS—These famous fast cutting and long wearing buffs continue to set the standard of performance for bias-type cloth buffs. You can depend on uniform quality from shipment to shipment.

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TAKE THE **LOAD** OFF YOUR **TOP BRASS**

USE **TRUE BRITE BRASS SOLUTIONS**

Trouble Free — Low Cost
Little Supervision Needed
Ready To Use — Just Add Water
Uniform Color — Can Match Colors

Write For Bulletin on Brass Plating

TRUE BRITE CHEMICAL PRODUCTS CO.
BOX 31, OAKVILLE, CONN.

J. George Warneck

by *Sel-Rex Corp.*, Nutley, N. J., manufacturers of precious metal electroplating processes. Mr. Warneck, who was president and general sales manager of his own company, Warneck Industries, will handle sales and service of semi-conductor rectifier equipment and automatic metal processing machinery, manufactured by *The Meaker Co.*, Chicago, a wholly-owned Sel-Rex subsidiary.

Mr. Warneck attended Los Angeles City College where he majored in Mechanical Engineering. Among the technical and executive positions held during his 20 year career in industry were: mechanical engineer with Lockheed Aircraft Co., of Burbank, and consulting engineer to prime and subcontractors in various missile and rocket projects.

Mr. Warneck will operate principally in the Los Angeles and San Diego areas, under the direction of West Coast manager *Walter Walczyk*.

Mrs. Vonna Ott, owner of Process Engineering Service, a finishing shop at 1243 North Fair Oaks Ave., Pasadena, Calif., which specializes in printed circuit plating, reports she has completed organization of a new company known as Circuitronics.

The new firm is housed in a 2,500 square foot building at 1233 N. Fair Oaks Ave., adjoining the Process Engineering Service shop, and went into operation on November 1. The new plant, Mrs. Ott reports, is equipped with a 24-inch camera, a dark room and etching and fabrication equipment for specializing in circuit board work. The facilities of Process Engineering Service will be consolidated in the new plant building in January, 1961.

Mrs. Ott is the only woman operator of a plating plant in Southern California, a distinction of which she is quite proud. *Carl Rundage* is plant foreman.

Patrick Osborne recently bought out the interests of his partner, *Hillyard Hill*, in Sure Plate Co., Fullerton, Calif., and now operates the firm as sole owner. The shop is equipped for hard chromium and cadmium plating. Much of the firm's work consists of parts and meter housings for meters manufactured by the American Meter Co. of Fullerton.

Krentel Plating Co., which is operated at 141 N. First St., Burbank, Calif., by *G. Stuart Krentel*, has expanded its facilities by the addition of equipment for zinc plating and plating zinc die castings with copper, nickel, and chromium.

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Electrode
Rod Insulator

One-piece steel, heavily coated with plastisol... no spacer needed. Easy to install. Universal application. Standard sizes stocked. For details, call or write

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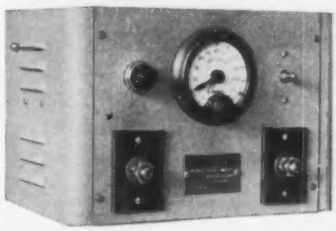
SAVE PRECIOUS METALS and PRECIOUS TIME with MACARR AUTO-TIMING CONTROL



How It Works:

Connect in the cathode line, plug into 115V AC source, set timer, and put MACARR PMC "on" — Insertion of work on cathode rod of any amperage between 2 and 150 will automatically start timer, will time for preset interval. Simultaneously at this point a visible and audible alarm operates; also current to work is automatically reduced to a level where it is not plating or deplating. Removal of work resets PMC and it is ready for next load without the operation or manipulation of any switches.

PMC-150 Model—2-120 second time range with 2A to 150 current rating. Other models available with special time and current ranges.

Write for descriptive literature

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4360 Bullard Ave., Bronx 66, N. Y.
Telephone FAirbanks 5-5510

Krentel resigned as technical sales engineer for Kelite, Inc., in Los Angeles to establish his own plating plant in February, 1960. He acquired equipment for a job plating shop from *Robert B. Gray*, operator of the Duraplate Corp., in Burbank. In addition to the new facilities, Krentel's plant is equipped to do decorative nickel and chromium plating on a production basis.

A refinement of the cadmium plating process which increases the strength of high-strength steel and makes weight reductions in airframes possible is reported to have been developed by chemists of the Lockheed Aircraft Co., Burbank, Calif. Basis of the process is the use of chemical additives to eliminate the effects of hydrogen gas which effects the strength of steel.

The process involves the introduction into the solution of a nitrate compound as an additive which assimilates hydrogen produced by water electrolysis in the plating bath. A special brightener patented by the company is used as a further addition to increase the bath's plating efficiency.

A. M. Folden is director of the operations, under whose supervision the new plating procedure was developed during a five year research period.

Industrial Filter & Pump Co. has assigned *Rocky Gray*, of its Chicago headquarters, to service the Southern California area as district manager. He assumes the duties formerly handled by *Kenneth C. Johnson*, who resigned. Gray made a swing through the western district territory in November and took occasion also to attend the monthly meeting of Los Angeles Branch, A.E.S.

A new technique for potting and protective coating application for complete computer assemblies reportedly has been developed by the Librascope Division of General Precision, Inc., Glendale, Calif. The parts of computers which are being given this treatment are the printed circuits which comprise the so-called "intelligence" of electronic digital computers. The protective material used is an epoxy resin which is applied either by dipping or spraying the sub-assembly parts.

George Magurean, a past-president of Los Angeles Branch of the A.E.S., directs the printed circuit processing operations in the Librascope plant.

Fred B. Stieg, manager of the technical service laboratory of Titanium Pigment Corp., New York, recently presented a talk on "The Production and Control of High Dry Hiding" at the monthly meeting of the Los Angeles Society of Coating Technology.

The speaker related the Fresnal equation pertaining to reflectance and refractive index, along with pigment spacing formulas in a hiding power equation. He also discussed relative volumes of air and vehicle solids present in the voids of a given pigmentation.

The annual Christmas Party and Dance of the Lost Angeles Paint & Varnish Production Club was held at the Candlewood Country Club in Whittier, Calif., on the night of December 2.

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A Precision
DUAL BARREL Finisher

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POLISHING • BURNISHING
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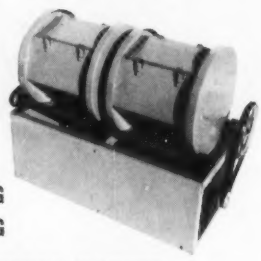

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for longer Service . . .

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Heavy gauge steel with wire woven through steel angle firmly attached to main stem. Cannot come apart or loosen. Side clip is for STUTZ BARREL PLATING TANKS having submerged rectangular anode bars. Side clip not furnished for racked plating tanks. Standard hook 6 inches. Other hook lengths available, however deliveries could be delayed.

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Note how welds have dissolved or broken in use. Often caused in barrel plating where currents are high and barrel transfer is rapid.

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New York Branch

Nov. 11 was *Dave Clarin Night* in New York. Many old and new friends from the Newark and New York Branches turned out to honor Mr. Clarin. The meeting was called to order by President *Joseph Rembecki*, and a motion was made and carried to dispense with all business except applications for membership.

President Rembecki read a letter from the secretary of the Newark Branch, *Dr. Donald G. Foulke*, to Dave, praising him for his services to the A.E.S.

Ralph Liguori spoke about the old times and Dave Clarin's work in the local and national levels of the Society. Ralph presented Dave with a transistor radio from the New York Branch. A plaque, which was to be presented, will be sent to him at a later date.

Milton Nadel also covered some of Dave's activities in the society and presented him with an Honorary Membership to the New York Branch. Dave took the floor to thank all concerned with this night. He told the history of how the Aunt Ella luncheon was started, also remembering the good times had in past conventions.

Librarian *Martin Pollack* took over for "Good and Welfare." Martin introduced *Tom Downey*, of Pfizer Chemical Corp., who spoke on "Organic Acids and their Salts used in Anodizing and Plating." Mr. Downey received a rousing round of applause following his talk.

After the meeting the members and guests retired to partake of refreshments and review past experiences with the guest of honor.

Fred Saras,
Recording Secretary

(Courtesy of John Kosmos)

New York Branch President, Joe Rembecki, presents Dave with a transistor radio.

(Courtesy of John Kosmos)

Dave is surrounded by some of his many Newark Branch friends who crossed the river to honor him.

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Exceptionally wide overlapping fingers for

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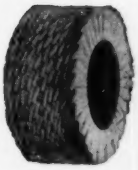

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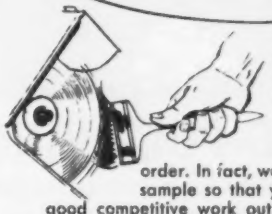

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Syracuse Branch

The monthly meeting was held at the Turn Hall on Monday night, Nov. 21. After a short business meeting, an interesting talk was given by *John Winters*, of Incar Inc. of Cleveland, Ohio, whose subject was on cadmium and zinc plating at the job shop level. The talk was followed by a lengthy question and answer period. Refreshments were then served, courtesy Incar.

Twenty-seven members and three guests attended the meeting. The guests were *Jack Little* and *Ed Perry* of the Cleveland Branch and *John Siefen* of the Detroit Branch.

Rene Sonnenfeldt,
Recording Secretary

Columbus Branch

The Branch met at Battelle Memorial Institute on Nov. 4, with the president in the chair.

Marvin Pingle reported that he had contacted 102 suppliers and had sent publicity folders to Louisville, Indianapolis, Dayton, Cincinnati and Cleveland regarding the Tri State Meeting that will be held in Columbus, February 4, 1961. A motion was made and adopted that the board be asked to consider using Branch funds for paying service charges and tax at the dinner meeting.

Charles Kramer of Marine Products spoke on applications of rigid plastics in plating rooms, especially in regard to their corrosion resisting properties. Mr. Kramer is well known as an expert in this field. His presentation was excellent.

Mary Fulmer,
Secretary

Blue Ridge Branch

The third annual Dixie Regional Technical Session will be held on February 3-4 at the Hotel Roanoke, Roanoke, Va., Blue Ridge Branch, host.

On the morning of Friday, Feb. 3rd, there will be a plant tour of General Electric Co., Salem, Va., and for the ladies a tour of Natural Bridge and a luncheon. In the afternoon the first educational session will be held, followed by the MFSA get-together party.

Saturday morning the second educational session will be held, and in the evening there will be a cocktail party, banquet and dancing.

Speakers for the technical sessions are: *C. H. Castle*, vice president and technical director, Abrado Finish Corp., Grand Rapids, Mich., "Application of Barrel Finishing Methods"; *H. B. Koehler*, manager, electrical sales, Hanson-Van Winkle-Munning Co., Matawan, N. J., "Rectifier Control in Plating"; *C. G. Haupt*, chemist, Norfolk & Western Railway Co., Roanoke, Va., "Aspects of pH in Electroplating"; *J. B. Winters*, president and technical director, Incar, Inc., Cleveland, O., "The Anode Side of the Story"; *Ezra A. Blount*, editor, Products Finishing, Cincinnati, O., "The Japanese Finishing Industry Today"; *Dr. H. J. Read*, State University of Pennsylvania, University Park, Pa., "Hydrogen Embrittlement in Electroplating."

Further information may be obtained from *Bruce E. Wallace*, chairman, P. O. Box 4237, Winston-Salem, N. C.

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NEW YORK BRANCH A. E. S.

ANNUAL EDUCATIONAL SESSION

February 4, 1961

STATLER HILTON HOTEL — NEW YORK CITY

Technical Session — 2:00 p.m.

Dinner-Dance — 7:00 p.m.

British Columbia Branch

The general meeting on Nov. 7 was held at 7:30 P.M. in the Loughead Hotel, Burnaby, with Vice-Pres. *Heinz Schenke* in the chair.

The guest speaker, *K. P. Bellinger* of Conversion Chemical Corp., Rockville, Conn., was introduced by *J. Lee*. The subject of his talk was "Trouble Shooting in The Plating Room," particularly stressing cadmium and zinc dyes for industrial purposes, and color coating on zinc.

The ensuing question and answer period lasted until the meeting adjourned at 10:30.

C. Schlossareck,
Secretary

Phoenix Branch

The November meeting was held at the Arizona Ranch Home Inn at 5614 North Central. After an excellent chicken dinner and anniversary cake, *Floyd Huhn*, president, opened the business meeting. One guest, *Tom Clow*, of General Electric, was welcomed.

John Mullarkey gave a report on the plans for Christmas Dance and everyone was urged to sell tickets. It was suggested that a letter be sent to all the wives inviting them to come. The treasurer's report was read and approved.

After the business meeting, *Bob Hays*, branch librarian, introduced *Fred Nobel* of Lea-Ronal, who spoke on "Bright Gold Plating." Many questions asked afterwards indicated great interest in the subject, and the meeting was adjourned at 9:15.

Paul M. Wible,
Secretary

Rockford Branch

The Branch honored its ladies at the annual Ladies Night Dinner, held at the Holiday Inn, Rockford, Ill. on Nov. 14. A record crowd of 85 ladies, members, and guests enjoyed a fine dinner and an evening of good fellowship and fun.

In deference to the ladies, the usual technical talk was dispensed with and a very interesting discussion, "Color Begins With You" dealing with modern unity of color in home decorating schemes was heard. *Miss Irma Dutrieux*, color stylist for the O'Brien Paint Corp., a recognized interior decorator, writer of color articles for a leading home decorating magazine and guest teacher on color and its uses at the University of Oklahoma, was the speaker. The talk was well received by the ladies as they consulted with Miss Dutrieux on individual home decorating problems for nearly two hours after the meeting. Wonder how many platers will have to do painting on Saturdays?

A short film showing the highlights and beauty of Boston was shown in an effort to promote family vacations in connection with the forthcoming convention.

Alexander Alexander,
Publicity Chairman

Southeastern Branch

The Branch held its regular monthly meeting on Nov. 11, 31 members and guest attending, *Myron M. Randman* presiding. Randman was welcomed back to good health as he made his first appearance since a recent lengthy

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illness. It was announced that plans and reservations are being considered for the 1962 Dixie Regional Meeting which will be held February 12, 13, 1962 at the Dinkler Plaza Hotel in Atlanta. A general chairman is not yet appointed. On the long range side it was announced that *Clem Hohner*, charter member and untiring faithful committee worker, has been appointed general chairman for the 1966 National Convention in Miami.

Clem Hohner introduced the speaker for the evening, *Dr. Richard B. Saltonstall* of the Udylite Corp., who spoke on air agitation for plating baths. Platers from Greeneville, Tenn.; Athens, Ga.; Anniston, Ala.; Carrollton and Adel, Ga.; and Atlanta were very interested in Dr. Saltonstall's explanation of the pros and cons of all types of agitation.

Robert Probert

Waterbury Branch

The branch held its regular monthly meeting at the Roger Smith Elton Hotel on Thursday, Nov. 10. A report was submitted by the members of the branch who attended the planning meeting for the 22nd New England Regional. Included with this report was a report concerning the Interim Meeting to be held in Hartford on February 11, 1961. The branch started a committee to select an "Old Timer" who is to be honored on the occasion.

Three new members were installed: *Evan Quartan, Edward Duncan* and *Peter Russo.*

Technical Chairman *Robert Bair* introduced the speaker of the evening, *Al Weisberg*, of Technic, Inc., who spoke on "Precious Metals in Printed Circuits." Mr. Weisberg gave case histories from his experience and enumerated the troubles frequently encountered in the plating of printed circuits. He explained the process and its problems throughout the entire process and how procedures seemingly unrelated to plating eventually cause plating problems. It was an excellent paper, well received.

F. A. Schneiders,
Publicity

Buffalo Branch

The Branch held its third meeting of the new season on Friday, Nov. 4, at the Niagara Manor, Buffalo, N. Y. with 30 members and 2 guests in attendance. Guests of the evening were: *Carson Talsma*, Barcalo Mfg. Co., and *Frank Baldwin*, S. A. Day Mfg. Co.

John Donaldson, chairman of the membership committee, announced he has approximately seven prospective new members. *Chuck Fotheringham*, chairman of the forthcoming Christmas Party to be held Saturday, Dec. 3, stated the committee has planned an evening's entertainment that should prove worthwhile to members and guests. It will include gifts for the ladies, roast beef dinner, door prizes, dancing and entertainment. Motel reservations at the Ellicott Park Court Motel will be available for overnight guests.

It was announced that *Robert Potter* passed away at home after being ill for quite some time. A moment of silent prayer was offered for Mr. Potter, a long time member of the Buffalo Branch.

Librarian *John Tiebor* introduced the speaker of the evening, *Ted Sward*, assistant sales manager of the Industrial Filter and Pump Mfg. Co., who presented an informative talk on types of pressure filters most often found in the filtration of electroplating solutions, and a discussion of the advantages and operating characteristics of each type. Mr. Sward also distributed to all members tables showing the flow rates for various plating baths.

Following the talk, Mr. Sward held an open question and answer period from the floor. The meeting was then closed by President *Harold Shapiro.*

Robert C. Eich,
Secretary

Chicago Branch

The regular meeting was held on Friday, November 11, at Petricca's Restaurant, 510 North Western Ave. One application for membership was received and three new members were elected to the Branch. *Joe Corre* read a letter from *Lou Rague*, chairman of exhibits of the 2nd Annual Midwest Conference which was held at South Bend, Ind., commending the Chicago Branch for their fine exhibits. An early reminder-the annual educational session and banquet will be held at the Conrad Hilton Hotel on Saturday, January 28, 1961. *Si Gary*, librarian, has arranged for *Ezra Blount*, editor of *Products Finishing*, to talk on "Plating Practices in Japan and the Far East" and *Myron Diggin*, technical director of Hanson-Van Winkle-Munning Co., to talk on "Plating Practices in Europe and Asia." *Scott Modjeska*, chairman of the banquet committee, and his group are working hard to make the banquet more than worth attendance.

Art Bartmann, of Bell & Howell, a member of the librarians committee, conducted a panel discussion on "Organic Finishing." The members of the panel were *Curtis Simmons*, president of Enameled Steel and Sign Co.; *Maurice F. Loeffel*, who substituted for *Charles Burak*, of Macco Products Co.; *Joseph Pokorny*, chemist and service engineer of the Blakeslee Co.

A very lively question and answer period followed, and the chairman and members of the panel were given a rising vote of thanks for their interesting talks and discussion.

Christopher Marzano,
Publicity Chairman

Newark Branch

President *John Banta* called the Nov. 18 meeting at the Robert Treat Hotel to order at 8:30 PM with 65 members and guests in attendance. One application was received; and three were elected to membership, namely Messrs. *Charles G. Muller* of Industrial Systems Co., *George DuBari* of International Nickel Co., and *Dr. G. Duffield Swan* of Metal Processing Co.

Under unfinished business: the Christmas Party program was announced. *Cy LaManna* stated that the Electroplating Course is accepting enrollees up to January 7. The course will begin on February 7, 1961. *Ray Abazia* stated that he was having difficulty with publicity of the Branch activities, but will continue his efforts in this connection. A moment of silence was observed for *Thomas Haddow* who passed away. Mr. Haddow was an honorary member of the Branch.

The meeting was then turned over to Mr. LaManna who introduced *Manuel Ben* as the speaker of the evening. Mr. Ben briefly outlined the early methods of plating on aluminum. He then explained in great detail the methods used by General Motors for plating on aluminum as well as discussing some of the more recent developments in plating this metal. His talk included also the corrosion of aluminum such as roof exposure tests, test details on taxis in the Detroit area, as well as the Cass tests.

The question and answer period which followed this talk was the live-

liest one for some time. Mr. Ben was given a rising vote of thanks for a very creditable presentation and the meeting adjourned at 10:30 PM. However, many lingered long after the meeting for further discussions with Mr. Ben.

Gustav Bittrich,
Assistant Secretary

Los Angeles Branch

Developments in the chemical conversion coatings field, which have come about since he last addressed the branch two years ago, were outlined at the Nov. 9 meeting by *Kenneth P. Bellinger,* of Rockville, Conn., president of the Conversion Chemical Corp.

In this talk Mr. Bellinger introduced a new procedure in that, instead of presenting a prepared paper on the subject, he offered commentary on a series of slides, graphs and photographs, for which *Don E. Baudrand,* the educational committee chairman of the branch, acted as projectionist.

In a further departure from conventional practice, members of the audience were permitted to ask their questions immediately after a slide and its commentary by the speaker had been concluded. This proved a welcome change from the usual practice of holding all questions until the address had been concluded. It was found to be an improvement in that the members could ask questions while the discussion on a subject and the illustrating material were still fresh in mind.

The business session was conducted by first vice-president *Emmet H. Babcock,* who presided in the absence of president *Frank Virgil.* Babcock initiated three new members — *Charles Garrison, Grant Ward,* and *Ralph Shaefer.*

William Thomas, general chairman of the branch's 1961 annual educational session, announced appointment of the following sub-chairmen: Technical speakers, *Don E. Baudrand;* hotels, *Berry Blackburn;* printing, *Gene Weiner;* publicity, *Bert Adams;* reservations, *Hal Wannamaker.* The sessions will be held at the Statler-Hilton Hotel in Los Angeles on April 8, 1961.

Norman Painter of the Hal-Mak Co., where *Don Bedwell* served for two decades as plant superintendent, reported that Bedwell recently underwent an operation in Inglewood Hospital. He reported that Don came through the surgery successfully. Don, who has been retired for some three years, is an honorary member of the A.E.S.

An observer at the meeting, to learn how American platers conduct their industry conferences, was *Egidio Meza,* general manager of Acanados Industriales Ltda. a firm which operates the largest job plating shop in Medellin, Columbia. Meza was in the United States to inspect barrel plating equipment which his company plans to add to its facilities for plating metal furniture, building hardware, and automobile parts.

Chairman Babcock announced that, because the meeting date for that month falls so close to the Christmas holidays, the branch will hold no meeting in December. The next meeting was scheduled for Jan. 10.

Blue Ridge Branch

The Branch held its regular monthly meeting on Nov. 4, at the Elks Club in Roanoke, Va. Nineteen members and guests attended the meeting. Visitors introduced were *Harold Huffman, Bill Huffman, Sam Huffman, C. J. Looper,* and *Charles Garrett* of Carolina Plating; *S. M. Proco* of Poly Scientific Corp.; and *John G. Mason* of Dixie Engraving Co. At the business meeting, four new members were elected. They are: *David B. Gibson, Elmer I. Nichols, F. M. Travis* and *Joe C. McDowell.*

After the business meeting *Bruce Wallace* introduced *Dr. Nelson Murphy,* who presented a talk on the topic "How Acid Inhibitors Work." Dr. Murphy is a Branch member and a research professor in the Chemical Engineering Department of Virginia Polytechnic Institute.

Donald H. McGee,
Secretary

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Detroit Branch

The big year-end meeting was held on December 2, at the Statler-Hilton Hotel in Detroit. All of the national officers of the AES attended as guests. Among them were Messrs. *Chester Borlet*, first vice-president; *Manuel Ben*, second vice-president; *Frank Beuckman*, third vice-president; *Ralph Wysong*, past president; *John Nichols*, executive secretary; and *I. M. Weiss*, membership chairman. *Dr. W. Andrew Wesley*, national president, acted as technical chairman.

The speakers, *H. Kahler* of General Motors Corp., *V. Cassidy* of Ford Motor Co., and *G. Levy* of Chrysler Corp., dealt with the subject "Service Performance of Automotive Trim."

A spirited technical discussion was carried on. Later, under the leadership of Mr. Weiss, an exchange of membership promotional ideas brought the meeting to an optimistic close.

W. G. Anderson

Blue Ridge Branch

The Branch held its regular monthly meeting on Dec. 6 at the Elks Club in Greensboro, N. C. Thirty members and guests attended the meeting. At the business meeting the secretary, *Donald McGee*, announced that Poly Scientific Corp. of Blacksburg, Va. had been elected a sustaining member of the society. This is the first company to become a sustaining member for the Branch. The next item of business was the election of new members. Five new members were elected. They are: *Lawrence Walker*, *Richard A. Bryant*, *F. R. Holliday*, *C. M. Butler*, and *Roy R. Lewis*.

After the business meeting, those attending heard *Michael Milo*, Western Electric Co., speak on "Life and Freedom Behind the Iron Curtain." The regular speaker for the evening was *Dr. Nelson Murphy*, Virginia Polytechnic Institute, who spoke on the subject "How Acid Inhibitors Work, Part II."

Donald H. McGee,
Secretary

Acid-Proof Cement Mfr's. Assn.

The Association, at its annual meeting in Philadelphia, Nov. 11, 1960, elected as its president for the coming year *Dr. C. R. Payne*, president, Electro-Chemical Engineering & Mfg. Co.

The Association is representative of manufacturers of sulfur, resin and asphaltic types of acid-proof cements.

American Ordnance Assn.

Myron B. Diggin

Dr. R. B. Saltonstall

At the Twenty-eighth meeting of the Surface Preservation Section, Production Techniques Division, American Ordnance Association held at El Paso, Texas and White Sands Missile Range. N. M., Nov. 1, *Myron B. Diggin* of Hanson-Van Winkle-Munning Co. was elected chairman and *Dr. R. B. Saltonstall* of the Udylite Corp., secretary to serve terms of two years.

Industry members of this section work closely with governmental and military personnel in an attempt to solve problems relating to the corrosion or deterioration of military material.

National Association of Corrosion Engineers

H. R. Copson, International Nickel Co. Research Laboratory, Bayonne, N. J., will receive the Whitney Award and *Kenneth G. Compton*, Bell Telephone Laboratories, Inc., Murray Hill. N. J., will be presented the Speller Award during the 17th Annual Conference and 1961 Corrosion Show of N.A.C.E. at Buffalo, N. Y., March 13-17. The Willis Rodney Whitney Award is given in recognition of public contributions to the science of corrosion. The Frank Newman Speller Award is given in recognition of public contributions to corrosion engineering.

New officers for the Association have been elected for 1961-62. *E. C. Greco*, senior research chemist for the United Gas Corp., Shreveport, La., has been elected president; *Rolland McFarland*, secretary and technical director of Hills-McCanna Co., Chicago, has been elected vice-president; and *C. G. Gribble, Jr.*, district manager for the Metal Goods Corp., Houston, has been re-elected treasurer. All officers will be installed March 17, and will serve for one year.

Three directors of the association also have been elected. They are: *Frank E. Kulman*, senior engineer, Consolidated Edison Co. of New York, Inc.; *L. W. Gleekman*, supervisor of the materials engineering group, engineering department of Wyandotte Chemicals Corp., Wyandotte, Mich.; and *Fred D. Stull*, superintendent of corrosion prevention, Texas Gas Transmission Corp., Owensboro, Ky. Mr. Kulman will represent active members of N.A.C.E., while Dr. Gleekman and Mr. Stull will represent corporate members. All will serve for three years.

N.A.M.F.

The Western Pennsylvania Association of Metal Finishers, an organization of job metal finishing firms in the

Andrew Benko, III (left) receives charter from President Robert L. Geisel. Seated is Saul Green, treasurer of the affiliate.

Greater Pittsburgh area, has been admitted into the National Association of Metal Finishers. Formation of the group took place on Dec. 2 at Pittsburgh's Penn-Sheraton Hotel when a charter was presented to *Andrew Benko, III*, president of the new affiliate, who heads Pittsburgh Quality Plating Co.

Charter members of the WPAMF are Pittsburgh Quality Plating Co., Cowan Mfg. Co., East Liberty Electroplating & Refinishing Co., Electroplating Inc. of Pittsburgh, Jersey Chrome Plating Co., Keystone Rustproofing, Inc., all of Pittsburgh; Metal Ox Anodizing & Finishing, Inc., Braddock; Erie Plating Co., Erie; and American Plating Co., Inc., Zelionople.

Already the new N.A.M.F. affiliate — one of 16 which belong to the parent association — has embarked on a drive to fight a Pa. board of finance and revenue ruling which makes it mandatory for job metal finishers to pay a 4% tax on all materials used in the finishing process, *retroactive to 1956*. A court "test case" involving one of the local member firms, Erie Plating Co., resulted in a favorable decision last year, only to have the board of finance and revenue appeal to the Dauphin County Court recently. A decision on the appeal is expected in the next few weeks. Pennsylvania job platers face a levy of $5,000 to $30,000 each, annually *retroactive to 1956*, if the Erie Plating decision is reversed.

Abrasive Grain Association

John H. Simonds, president of Simonds Abrasive Co., Philadelphia, Pa. was elected chairman of the board of directors of the Association at its recent meeting held at the Whittier Hotel, Detroit, Mich.

The Association is a trade organization whose ten members are leading manufacturers of aluminum oxide and silicon carbide abrasive grain. It is organized to promote the best interests of the industry and the users of its products, it develops standards for the products of the industry and conducts research in areas of common interest.

John H. Simonds

NEW BOOK

Chemical Engineering Catalog

Published by Reinhold Pub. Corp., 430 Park Ave., New York 22, N. Y. 1960. 1670 pages.

The forty-fifth annual edition/1961 of this guide for buyers of process equipment is available without charge to users of engineering materials and apparatus. The catalog is indexed, as in past years, by companies, functions, equipment and materials of construction, engineering services, and trade names. Following this section will be found catalogs of companies referred to, including the latest developments in equipment, in alphabetical order.

The catalog offers time-saving convenience and serves, as usual, as the leading source of information on products and services.

OBITUARY

DR. RICHARD SPRINGER

The many friends and acquaintances of *Dr. Richard Springer*, 58, well-known consultant in the metal finishing field, are saddened by his death, on November 25th after a lingering illness of a year. Dr. Springer, who lived in Frankfurt am Main had many friends in the U.S.A. During his last visit in the U.S.A. he attended the International Conference on Electrodeposition at Detroit in 1959.

PATENTS

(*Continued from page* 59)

Paint Spraying Apparatus

U. S. Patent 2,955,568. *Oct.* 11, 1960. *W. G. Blenman and W. A. Brady, Jr., assignors to General Motors Corp.*

A machine for spray painting a plurality of relatively offset surfaces on an object.

Electroless Nickel Plating Bath Control

U. S. Patent 2,955,944. *Oct.* 11, 1960. *R. A. Spaulding, assignor to General Motors Corp.*

In a chemical reduction plating process utilizing a plating bath com-

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PATENT PENDING

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prising an aqueous solution of a water-soluble nickel salt and a hypophosphite reducing agent, the improvement which consists in maintaining the desired nickel concentration in the bath by additions of a water insoluble nickel compound which is adapted to increase the pH of the plating bath.

Gas Plating

U. S. Patent 2,955,957. *Oct.* 11, 1960. *H. Dorner, assignor to Interchrome S. A.*

A process for coating ferrous metal with chromium by diffusion, which comprises carrying out the diffusion in a closed container having an inlet for inert gas without any outlet therefor by heating said container and its contents in a furnace and withdrawing the container from the furnace when heating is completed, and admitting the inert gas into the container at least after completion of the heating as soon as pressure within the container begins to fall below atmospheric pressure.

Chemical Nickel Plating

U. S. Patent 2,955,959. *Oct.* 11, 1960. *A. H. Du Rose*

A process comprising subjecting a surface of a workpiece to be coated with nickel to a body of chemical nickel plating solution comprising nickel cations and hypophosphite anions for time sufficient to produce a coating of desired thickness, said solution, except essentially a thin layer thereof closely adjacent to said workpiece surface being maintained at temperatures below the precipitating temperature thereof, said surface of said workpiece being maintained at temperatures above the precipitating temperature of said solution and below the boiling point thereof whereby a thin layer of solution adjacent said surface is at a temperature above the precipitating temperature of said solution and below the boiling point thereof, said surface of said workpiece being composed of a substance of the class consisting of copper, silver, gold, beryllium, boron, germanium, aluminum, thallium, silicon, carbon, vanadium, molybdenum, tungsten, chromium, selenium, tellurium, titanium, iron, cobalt, nickel, palladium, platinum and alloys thereof.

Paint Stripper

U. S. Patent 2,955,965. *Oct.* 11, 1960. *C. H. Coleman, assignor to the United States of America*

A method of rapidly removing an organic coating from tin plate without attacking the metal, comprising immersing the coated tin plate in a hot solution of aniline and ammonia in water.

Phosphating Process

U. S. Patent 2,955,967. *Oct.* 11, 1960. *B. Blaser and E. Mayer, assignors to Amchem Products, Inc.*

A heavy-metal phosphating solution containing as an addition agent, from 0.1 to 10 grams/liter of a water-soluble salt of phosphoric acid having a P—P bond in which the oxidation number of a phosphorus atom is less than five.

Chrome Protector

U. S. Patent 2,956,888. *Oct.* 18, 1960. *P. E. Gunning, assignor to Union Carbide Corp.*

Aqueous emulsion of wax for protecting chrome and steel surfaces, consisting essentially of wax, by weight 1.75 to 2.25% barium dinonyl sulfonate, 2.5 to 3.5% dimethyl polysiloxane, 1.75 to 2.25% morpholine, oleic acid, 4 to 6% hydrated silica, 25 to 35% mineral spirits, and the remainder water, the proportions of said wax and said oleic acid being adjusted to an acid number within the range of 110-150.

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TECHNICAL DEVELOPMENTS

(*Continued from page* 36K)

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351. A. J. Mitchell. U.S. Pat #2,960,420 (Nov. 15).
352. M. Weisberg & F. P. Butler. U.S. Pat. #2,937,940 (May 24).
353. B. J. Sherwood & W. R. Hoyt. U.S. Pat. #2,954,289 (Sept. 27).
354. N. Rain & S. A. Self. Electroplating, **13**, 283.
355. L. Wood. Electroplating, **13**, 286.
356. N. Ananiatis. Plating, **47**, 1023.
357. G. Fitzgerald-Lee. Prod. Fin. (Br.), **13**, 72 (Oct.).
358. L. E. Lancy. U.S. Pat. #2,933,438 (Apr. 19).
359. H. C. Luechauer. U.S. Pat. #2,944,947 (July 12).
360. C. F. Hendee, W. B. Brown & S. Fine. U.S. Pat. #2,959,532 (Nov. 8).
360A. H. E. Coombes, Jr. Plating Mgt., **5**, 10 (Dec.).
361. H. W. Parker. Metal Prog., **77**, 82 (Feb.).
362. V. Evans. Corr. Tech. (Br.), **7**, 309.
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367. I. Korn, J. S. Kaye, V. C. Pierce, W. Walworth & J. Huscher. U.S. Pat. #2,956,915 (Oct. 18).
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373. A. Jogarao, K. S. Indira & B. A. Shenoi. Plating, **47**, 1368.
374. R. A. Botosan. Plating, **47**, 1364.
375. R. C. Spooner & D. P. Seraphim. Metal Finishing, **58**, 40 (Dec.).
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377. F. Passal. U.S. Pat. #2,962,428 (Nov. 29).
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ORGANIC FINISHING DEVELOPMENTS

(*Continued from page* 36P)

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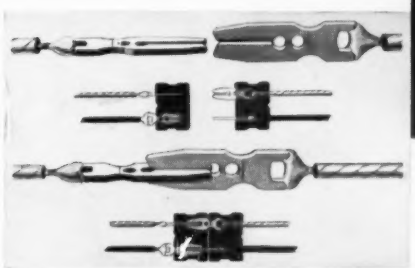

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